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**Royal Naval Medical Service**

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# Journal of the Royal Naval Medical Service

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## Editorial

We led farewell to Surgeon Rear Admiral Stanley Miles as Chairman of the editorial committee and welcome two new members Surgeon Captain (2411) H. H. Hall and Surgeon Commander P. C. Palford. Surgeon Rear Admiral Miles has been associated with the Journal for the past nine years and his considerable influence is reflected in the wide spectrum of naval medical interests which are now represented within its pages. He also served as Chairman of the Clinical Research Working Party and the organising committee of the Second Symposium of Naval Medicine. The proceedings of the symposium which appear in this number of the Journal, provide a fitting tribute to his energy and enthusiasm. Surgeon Rear Admiral Miles is now Dean of Postgraduate Medical Studies at the University of Manchester and is well known to our readers.



In view of the large number attending the symposium and the widespread interest aroused by the papers, the editorial committee has decided to publish the complete proceedings in a single number of the Journal. The symposium occupies in our issue, however, decided the end of printing and the present number therefore represents the combined Spring and Summer editions for 1970. The normal four monthly Journal will be resumed with the Winter number.

Subscribers will have received notice of an increase in our subscription rate for 1971. The present rate has remained unchanged since the Journal was founded in 1915. The new rate of 42 per annum is still very low compared with that of other medical journals and, of course, income tax relief may be claimed on subscriptions under the terms of Section 18 of the Finance Act 1958. It is essential to publish most news of the Service and information concerning related affairs who are directly related to medicine. The letter from Surgeon Captain Magnus on page 269 underlines the fact that many distinguished naval officers have something important to say. The Journal of the Royal Naval Medical Service is primarily a family affair and, while we should make every endeavour to improve its professional quality, it is important that we keep it so.

Contributors are asked to note that abstracts should now be provided with articles submitted for publication and that no future bibliographical references in connection with current practice should contain the title of the article and the name of the journal in full. Abbreviations are no longer in vogue.

## Second Symposium on Naval Medicine

Held at the Royal College of Physicians, London on 15 & 16 September 1965

### Opening Ceremony

Sir Alan Stevenson, President of the Royal College of Physicians, welcomed the Royal Naval Medical Service and their guests to the Royal College of Physicians for the Second Symposium on Naval Medicine. He commented on the close relations that existed for very many years between the College and the Navy and hoped that future conferences would similarly be held at the Royal College of Physicians.

The Medical Director General of the Navy, Surgeon Vice-Admiral E. R. Bradbury formally opened the Symposium thanking the Navy for the excellent facilities which the College had provided and expressing his appreciation of those who had put so much work into the planning of both the exhibition and the lecture programme. He made further mention of Dr Charles Newman's help and interest in organising the Library exhibition of Medicine in the Navy and thanked him for his enthusiasm and co-operation.

Finally, the Chairman introduced the First Sir Lord Admiral Sir Michael Le Fanu, inviting him to give an opening address on what the situation required of the naval doctor.

Sir Michael gave a short, amusing talk in which he emphasised that the prime requirements of the naval medical officer were to ensure that ships were manned with fit personnel and that the time lost by sickness was minimised. He commented upon the interesting content of the programme and gave the meeting his blessing.

### Film Development Section

The Symposium provided the occasion for a preview of a new film on Disease prevention techniques, reaching its final phase of production. The quality of the film was excellent and the clear exposition of the physiological principles and physical complications of decompression sickness were the subject of much favourable comment.

### Library Exhibition

Following the film Dr Charles Newman spoke for a few moments upon his library exhibition on Medicine and the Navy covering the nineteenth to the twentieth centuries. References to sea diseases as injured and medical issues were followed by extracts from Woodall, Lush, Shaw, Trotter and others. The eighteenth century was concerned with naval hygiene and the establishment of naval hospitals and the nineteenth with the structure of a comprehensive Naval Medical Service.

## SESSION I

### Urology

Chairman: Dr. Cecil Webster

## THE SIGNIFICANCE OF PROSTATITIS IN URINARY TRACT INFECTION IN THE MALE

By Norman J. Blacklock

### ABSTRACT

A review of all cases of urinary tract infection occurring in a mixed population group has been carried out over a four year period. There were 544 cases of cystitis-prostatitis; a previous vaginal infection did not occur significantly in these cases and the evidence appeared to be greater as married as opposed to single persons. The importance of direct examination of prostate fluid in the assessment of these cases is established. The response to initial treatment of the condition may be a guide to long term prognosis.

Cases of epididymitis and pyelonephritis were also considered during the same four year period. Evidence of a primary infection focus in the prostate gland in these conditions is established and the possible pathway and mechanism of infection from this focus is discussed. Attention is drawn, again, to the importance of examination of the prostate fluid in these cases. Effective treatment of these conditions must ensure eradication of the infective focus within the prostate gland as well, in order to maintain the chance of relapse.

In considering the significance of prostatitis in urinary tract infection in the male a four year survey of cases has been carried out—the period being years 1953 through 1956.

The intention is to stress the key role of the prostate as the principal source of focal infection in the male urinary tract. Inflammation of the prostate is considered as a distinct process in its own right and also as a focus of infection from which other inflammatory processes, such as cystitis, epididymitis and pyelonephritis, may develop (Giles, 1944; Gersman, 1934; Rosenkrantz et al, 1957; Raper, 1955). It is difficult to differentiate clinically between an acute prostatitis and an acute cystitis. In the age groups closely represented in this review it is likely that some cystitis cases occur without there being an already severe acute prostatitis. The condition is therefore better described as a cystitis-prostatitis.

The technique of investigation in all cases of urinary tract infection has been uniform. An initial and a subsequent urine are taken for general examination, microscopy and culture. Following this, prostate massage is carried out and a

specimen of prostatic fluid obtained by allowing it to drip freely from the washed material into an empty Petri dish. Where this specimen has not collected in a single large drop of fluid a wet loop has been used to make one isolated droplet continue onto one specimen. By this means sampling errors have been minimized. A loopful of this composite specimen is then examined directly by microscope of the wet film bench at a lower dry. The presence or absence of pus cells is noted together with their number and whether clumping is present. Where more than ten pus cells are seen uniformly present in each of thirty 1/40th microscope fields, there is fair evidence of an active inflammatory process being present within the prostate gland when additionally clumping of these pus cells has taken place, this suggests a degree of virus or infected prostatic ducts (Figure 196c). In addition to the specimen for the direct film a loopful of prostatic fluid is taken and cultured on chocolate agar.

The total number of cases of prostatitis found in the four year period was 261. Using statistical data obtained in another survey it would appear from this number that the incidence of the condition in the Navy is approximately 0.5 per thousand. The age-specific incidence has been assessed (Fig. 1) and this shows that prostatitis increases in incidence with age. This corresponds with the findings of other workers investigating this condition (Hastley, 1933; Major, 1937; Hopson, 1955). A further breakdown of the population into married and single personnel was carried out and this shows (Fig. 2) that the condition is significantly more common in married as opposed to single personnel on the age groups from 35 years to thirty. Beyond the age of thirty more than 85 per cent were married and it was not possible to produce

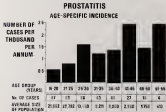


Fig. 1.

# PROSTATITIS

RELATIVE INCIDENCE IN MARRIED AND SINGLE PERSONNEL



Fig. 3

## PROSTATITIS SYMPTOMATOLOGY

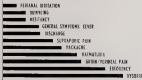


Fig. 4

statistically significant data. This observation has also been made by Leppanen (1961).

A history of previous venereal infections was found in 26 per cent. of the cases of prostatitis. A survey of the general incidence of urethritis is being presented shortly.

also, to be in the region of 25 per cent. The difference is not statistically significant suggesting that previous venereal infection is not a major factor in the aetiology of prostatitis in the Navy, this again corresponds with the findings of others (Clarman 1954, Markens 1959, O'Connor 1959).

The relative frequency of each symptom of prostatitis is depicted graphically in Fig. 3. It can be seen that the most common symptoms are those which are also associated with the diagnosis of cystitis and so referred to before. It is difficult to differentiate by symptomatology between these two conditions. It is unlikely that cystitis exists without an active prostatitis in this age group.

The most characteristic of the inflamed prostate gland are similarly depicted in graph form (Fig. 4); the most notable discrepancy is a loss of the normal homogeneous feel of the gland, this being replaced by a firm area or areas to give the impression of nodularity. Nodules may be present on one or both sides of the gland and are thought to indicate sites of inflammation. These nodules may persist permanently after an episode of infection or they may over a period of months resolve so that the gland becomes homogeneous once more. When the inflammatory state is very severe the gland feels characteristically tender and is unusually tender.

In the consideration of the aetiology of prostatitis the confusion has been introduced as between acute and subacute inflammation on clinical grounds. The distinction for such a subdivision is evident from a comparison of the factors

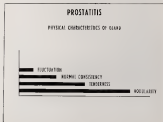
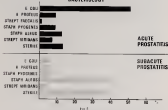


Fig. 4



# PROSTATITIS BACTERIOLOGY



## PROSTATITIS COMPARISON BETWEEN URINE AND PROSTATIC FLUID IN PROVIDING LABORATORY CONFIRMATION OF ACTIVE INFECTION

No. OF CASES 201

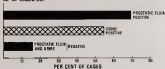


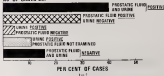
Fig. 4

specimen found in each group (Fig. 5). Culture organisms predominantly in the acute condition whereas *Neisseria* or no *Altera* predominant in the subacute inflammation. A large number of cultures were sterile. A significant number of cases which were subacute on admission to hospital had already had antibiotic for a varying length of time and there is no doubt that the bacteriology was considerably modified by this. Although it could well be that *Neisseria* were *Altera*'s counterparts from the lower members of the genus, a number of workers who adopt meticulous techniques in acquiring prostate sections have found the organisms commonly present in the vesicles from the gland (Kramer & Chastelain, 1955; Kirschner *et al.*, 1957).

A comparison was made between the findings in the urea and in the prostate fluid in each case (Fig. 6). From this it is apparent that prostate fluid is superior to urea in providing the evidence of infection. Figure 7 gives a more detailed analysis and, in particular, the degree of correlation between the findings in the urea and in the prostate fluid. In summary, the extension of examination of the prostate fluid in these cases can deepen the diagnosis of the very evidence for which he is seeking.

### PROSTATITIS COMPARISON BETWEEN URINE AND PROSTATIC FLUID IN PROVIDING LABORATORY CONFIRMATION OF ACTIVE INFECTION

No. OF CASES 200



In this series of cases relapse immediately following treatment occurred in 17 per cent. Recurrence at some time distant from apparent cure occurred in 19 per cent. Consideration was given to whether there was any relationship between relapse following initial treatment and a later recurrence since this would undoubtedly help in assessing the long term progress of such cases. Of 200 cases who responded satisfactorily to initial treatment with complete resolution of the condition, there was a recurrence of prostatitis at some time distant from the initial attack in 19. Of 15

cases who relapsed immediately following their initial antibiotic treatment but were later cured following a further course of antibiotic, or chemotherapy. 26 had a recurrence at some time during the study of prostatitis (Fig 4). The inference from these figures is that relapse in the time of the initial treatment of prostatitis is a factor of significance ( $p < 0.001$ ) in assessing the probability of a subsequent disease recurrence and should be taken into account in the time of planning the long-term follow up of such cases.

## PROSTATITIS

### RELAPSE FOLLOWING INITIAL TREATMENT AS A GUIDE IN LONG-TERM PROGNOSIS

RESULT OF INITIAL TREATMENT	SUCCESSFUL	OCURRENCE 19 (37%)	NO OCCURRENCE 31
	RELAPSE	24 (37%)	47

Fig 3

Of all the cases of prostatitis, epididymitis occurred as a complication directly in 7 per cent, acute pyelonephritis occurred as a direct complication in 1.5 per cent. Acute prostatitis appeared to obscure formation in only 0.7 per cent.

#### Epididymitis

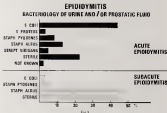
Although the pathway of infection to the epididymis may in some cases be haematogenous, there is considerable evidence to show that reflux of infected urine or prostatic fluid up the vas deferens from the prostatic urethra is more common (Kneudsmoen, 1834). In the respect the manner of clinical presentation is identical. Most acute cases of epididymitis have a history of onset of only several hours' duration. This best fits a mode of infection whereas there is a massive influx of infected material into the organ through the vas. In some cases the fulminating nature of the inflammatory process led to the suggestion that it is a hypermucous reaction in the nature of an Arthus phenomenon.

The mechanism of reflux via the vas deferens may be triggered as a direct pressure on the prostate urethra as may happen with a full bladder especially during sleep or accompanying erection, the external sphincter maintaining continence (Hobby 1944; Laitinen 1944). Many cases of epididymitis present initially with a feeling of an awakening from sleep with urinary pain. Other factors which may additionally predispose to urinary reflux into the vas are those conditions which will cause a rise of pressure in the prostatic urethra during micturition such as urethral stricture and mental stress. It is only when infection is already present in the prostatic urethra

that the reflex assumes significance by causing reflexes measured as he conveyed directly and in an unobstructed manner to the epididymis with resultant epididymitis.

If vasal reflex is the predominant pathway of infection to the epididymis it should be possible to demonstrate the primary infection focus in the prostate or prostatic urethra. There were twenty nine cases of epididymitis during the five years of the survey giving an incidence within the Navy of 0.58 per thousand. Investigation of these cases has shown evidence of active prostatitis in at least 74 per cent in the area of prostatitis. This is a maximum figure as a number of cases were treated initially elsewhere and the results of examinations of prostatic specimens were not recorded.

The bacteriology of the urine and prostatic fluid was considered, the cases being subdivided on clinical grounds into those which were acute and those which were subacute (Fig. 9). Again the majority with the subacute condition had had antecedent prior to admission to hospital with subsequent eradication of the bacterial spectrum recovered. The acute cases showed a preponderance of coliform infection.

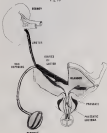
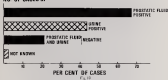


The significance of the finding of a sterile culture of urine or prostatic fluid is indicated in the main as to the prior treatment of cases with antibiotics. As in the case of prostatitis the findings on examination of urine and of prostatic fluid have been compared (Fig. 10). Again it was found that prostatic fluid provided positive evidence of infection more frequently than did urine. In other words significant evidence of active prostatitis has been found in a majority of the cases of epididymitis.

Half of all epididymitis immediately following treatment was found in 17 per cent. Perhaps, however, the most significant factor in these cases of relapse has been the

# EPIDIDYMITIS COMPARISON BETWEEN URINE AND PROSTATIC FLUID IN PROVIDING LABORATORY CONFIRMATION OF URINARY TRACT INFECTION

NO. OF CASES 37



finding of acute prostatitis in 83 per cent. It follows from this that if relief is to be obtained it is essential to ensure as far as possible that there is no lingering focus of residual infection in the prostate prior to the institution of antibiotic treatment or chemotherapy.

#### *Pyelonephritis*

Acute pyelonephritis occurred in a complication in 1.5 per cent of cases of prostatitis. Undoubtedly the mode of infection is pyelonephritis *via* ure and also different urinary age groups and as increases the more. In the mode of this age group mainly represented in the Norm. is the impression that the pathway of infection to the kidney is almost invariably the ascending one via the lumen of the ureter from the lower urinary tract.

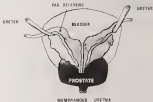


Fig. 22

As shown in diagram (Fig. 11 and 12) to the anatomical relationship of the prostate to the inguinal region of the bladder and ureters, and due to the particularly close relationship of the internal orifice to the lower course, inflammation of any severity in the prostate, or a combination of infection also in the ureters, and in the seminal vesicle, will inevitably cause trigonal reaction in the form of inflammatory oedema. This oedema may subsequently increase such as to involve the internal orifice and the lower ureter, the resulting increase in the rigidity of the lumen of the ureter leading to interference with the normal valvular mechanism at the vesicourethral and prostatic sphincters (cf. *et al.* 1917; Karschauer *et al.*, 1917). Pyelonephritis evidence of this has been obtained in a number of cases and an X ray from one such case is shown (Fig. 13). This was a case of acute pyelonephritis with a history and findings indicative of an immediately preceding prostatitis. It is apparent that the ureter is

it is not clear the site of infection is always low, and that the infection may be the cause of distended kidneys, a pyelogram of such cases is, therefore, of great aid and usually, effective in demonstrating such a fact. If the bladder stream is infected it may reflect up to the kidney and result in pyelonephritis.



Fig. 15

Clinically, if this is the mechanism the history of illness should provide symptoms of lower urinary tract infection for a varying time before the dramatic febrile episode heralding infection of the kidney itself, as this series of cases such a history has been noted almost invariably. Furthermore, it should be possible to isolate the organisms from the lower urinary tract.

The incidence of acute pyelonephritis in male sexual personnel was found to be in the region of 0.04 per thousand. The condition is therefore not uncommon as might be anticipated in a healthy and predominantly young male community.

The bacteriology of these cases is as shown in Fig. 14. In the 50 per cent in whom the culture was made there had been antibiotic treatment immediately prior to admission to hospital. In all cases the organisms included that of the pyogenic

# ACUTE PYELONEPHRITIS BACTERIOLOGY

ESCH. COLI	81	%
B. PROTEUS	8	
NO ORGANISM (PREVIOUS ANTIBIOTIC TREATMENT)	11	

Fig. 14

# PYELONEPHRITIS COMPARISON BETWEEN URINE AND PROSTATIC FLUID IN PROVIDING LABORATORY CONFIRMATION OF INFECTION

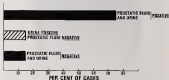


Fig. 15

fluid and the gross evidence of acute prostatitis is 11 per cent. A comparison between the urine and prostatic fluid in providing evidence of the nature of the infection (Fig. 15) is that various fluids were uniformly between urine and prostatic fluid, thus was shown in epididymitis.

Relapse following treatment occurred in 17 per cent but as with epididymitis the significant feature of all three cases of relapse was that an acute prostatitis could be demonstrated at the time that recurrence of symptoms occurred. Again three



appears to be no doubt that in the management of primary testis infection in the male it is essential to ensure that there is no residual focus of infection left within the prostate gland prior to the institution of treatment or surveillance.

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## THE MEDITERRANEAN MOTHER

By Alan S. Fekete

### ABSTRACT

The Maltese mother is compared with her British counterpart. Differences are discussed in terms of social, sociological, economic and religious influences. Trends in birth rate, maternal and perinatal mortality rates are reviewed and factors responsible for maternal morbidity are presented.

The aim of this paper is to describe certain aspects of pregnancy, labour and the postpartum in Maltese patients and to make differences between this and British experience. Material has been obtained from patients treated in the Royal Naval Maternity Unit in the past few years— from various sources carried out on Maltese patients in various hospitals, and by personal communication with Maltese medical colleagues.

### HISTORICAL

Several customs and traditions of those age fertility practices have been found in the Phoenician temple ruins on the Maltese islands. There are certain marked resemblances to the present century Maltese people in those customs. It is interesting to speculate as to whether this preserves the ideal Mediterranean fertile woman. The most ancient obesity, hairy postmenopausal, large breasts and thighs are all commonly seen in the present day Maltese women, especially after the age of thirty years.

### BIRTH RATE

The birth rate has dropped dramatically in Malta over the past 20 or so years. In 1949 it was 39 per 1,000 population while by 1967 it had fallen to 11 per 1,000. It is interesting to speculate on the reasons for this dramatic fall.

#### (a) Fertility awareness

There probably play a very small part in view of the more affluent society in Malta today compared with that of 20 years ago. Large families today appear to be largely confined to the lower social strata and low income groups.

#### (b) Education

Female education of a majority of the population has undoubtedly been a factor.

#### (c) Civil Movement and High Fertility

The influence of the Civil Movement must be viewed. It has encouraged the population in the day time market and in keeping contemporary dress. Although known to have a significant fertility rate, it more certainly be considered a form of birth control.

#### (c) Contraception

Contraception is practiced although no birth control pills have been sold since 1960. There is a growing number of abortions and, perhaps, miscarriages prior to 100 or the time of the pill, which is frequently prescribed as it is in England.

#### (d) Religious Influence

Although it would be incorrect to say that religious influence has diminished in the island it is probably less than compared with twenty years ago: the Church adopts a more enlightened attitude.

### MATERNAL MORTALITY

For the past 15 years there has been a continuing decline in maternal mortality in Malta. The downward trend compares favorably with the corresponding data for England and Wales (Canada 1965 Table 1).

Table 1

Maternal Deaths Per 100,000 Live Births

1956-1960	104
1961-1963	85
1964-1966	70
1967-1969	76
1970-1972	51
1973-1975	38

There were only 2 deaths in 1966 and 2 in 1967. The incidence of sepsis is now practically nil and the incidence of haemorrhage is small. However, the relative importance of sepsis as a cause of death has now almost disappeared and some of these deaths have to be considered inevitable.

### PERINATAL MORTALITY

The greatest of perinatal mortality rate has shown a satisfactory fall, particularly in the years 1963-1967, when the rate dropped from 40/1,000 to below 30/1,000 (Canada 1965). Prematurity and birth asphyxia still account for a high proportion of perinatal deaths, although it can be anticipated that higher standards of nursing care for premature babies will favorably influence the outcome. There is well illustrated by the high rate of collapse of premature babies in our own unit, which is due entirely to the quality of nursing care given to these babies. Birth trauma is another factor but, here again, the last four years have shown considerable improvement.

### DIABETES AND POTENTIAL DIABETES

It is now well understood that the diabetic phenomenon in established diabetes can likely be revealed in a pregnancy many years before the patient develops the full clinical syndrome. In pregnancy there is increased output of adrenocorticotrophic hormone, a possible increase of growth hormone which is closely related to the diabetogenic hormone and an increase of adrenal glucocorticoids and other steroids.

There is therefore a theoretical basis for impairment of glucose tolerance, insulin sensitivity and glucose metabolism during pregnancy in other words pregnancy is probably diabetogenic to those women with an inherent error of carbohydrate metabolism who should be classified as potential diabetics (Post, 1966).

In Maltese maturity onset type diabetes is much the commonest manifestation of the disease. It has been estimated that 20 per cent of the population of the Maltese Islands are liable to suffer from diabetes. These patients are usually obese and a family history of the disease is commonly obtained. An analysis of patients attending a diabetes clinic in Malta revealed that 60 per cent of the patients were overweight, with maturity onset type diabetes. Thirty-five per cent of the patients were grand multiparae and a high percentage volunteered that the onset of their diabetes occurred from late pregnancy to the first. Pregnancy well increased the potential diabetes, and it is then of great importance to the mother the fetus child, the placenta and puerperium that the condition is diagnosed.

Analysis of our cases of diabetes over the past five years reveals some interesting features. There have been twelve cases of diabetes or potential diabetes during this time and of these ten were Maltese. There was incidence of 0.5 per cent of all deliveries. The age incidence of onset of maturity type diabetes would appear to be somewhat lower than in Britain, as only one of these women was over 40 years of age. This is probably explained by greater parity and obesity. All cases except one were over 200 lbs. Five were grand multiparae. Only two cases required insulin for a short period before delivery and, in both these cases, the dosage required was low and was discontinued post partum. All patients except one gave a family history of diabetes. Ketosis was obtained in only two of the cases. Three cases were delivered by Lower Segment Caesarean Section, two had spontaneous deliveries, and the remaining five were induced at about 38 weeks. Three of the above cases demonstrated no glycosuria during pregnancy. Two of these were known diabetics and one was classified as a potential diabetic. Although the renal threshold is usually lower in pregnancy it was within the same and even on admission for treatment. Our incidence of glycosuria in pregnancy in Maltese patients over the past five years, including known diabetics, has been in the region of 15 per cent.

The problem of management of the potential and the established diabetics is not of the same magnitude as in the British female who commonly has a more severe form of the syndrome with a greater tendency to ketosis, and requires much more energetic intervention in the antenatal period. In the series from the diabetes clinic in Malta the intensity of treatment was less. Thirty per cent of patients were treated by diet alone, 30 per cent by a combination of diet and insulin and 40 per cent by a combination of diet and oral hypoglycaemics.

#### ESSENTIAL HYPERTENSION AND TOXAEMIA OF PREGNANCY

Our experience of cases of toxemia of pregnancy in Maltese seen at the Royal Naval Military Unit is that they are relatively mild compared with cases seen in the United Kingdom. Cases of fulminating pre-eclampsia toxemia have been few in number. There is an increased incidence of hypertension prenatally in the obese grand multiparae, but these patients tolerate pregnancy well on the whole.

and the associated symptoms) does not appear to be well understood. The Maltese anemia appears to have a more stable blood picture than the British anemia and the lack of a definite clinical classification of cases of pure idiopathic anemia.

The picture, however, appears to be different in the Maltese islands as a whole, as shown by maternal mortality figures, in which anaemia has been of relatively minor importance in a cause of neonatal mortality. There would appear to be a marked seasonal incidence in the islands, the peak periods being March-April and in November. No one has as far been able to reference any valid reason for this phenomenon.

# ANEMIA

A recent survey carried out in Malta showed that 25 per cent of neonatal Maltese patients first attending the Anti Malar Clinic had a haemoglobin concentration of less than 17 g per 100 ml and just over 10 per cent had a haemoglobin concentration of less than 11 g per 100 ml (Gallagher *et al.*, 1964). Patients of very high parity had a significantly lower haemoglobin and packed cell volume but mean corpuscular haemoglobin concentration remained very constant in the age and parity groups studied.

## The major causes of anaemia in Malta

The incidence of the major causes of anaemia in pregnancy was assessed using the following criteria obtained *et al.*, 1963):

### (1) Iron Deficiency

All patients with a serum iron less than 100 µg/100 ml, and showing hypochromasia and anisocytosis in the blood film were considered as iron deficient. This was not found if there was progressive improvement in the haemoglobin concentration and in the blood film, particularly with the presence of polychromatic erythrocytes, after oral therapy.

### (2) Folate Deficient Pregnancy

The diagnosis was made in those cases where the haemoglobin level was raised above 17 g per cent and a blood film showed significant morphological abnormalities of the erythrocytes.

### (3) Vitamin B<sub>12</sub> Deficient Pregnancy

The diagnosis of anaemia due to vitamin B<sub>12</sub> deficiency was only made when there was no other apparent cause for the anaemia, and a red blood specimen of more than 100 per cent. All patients had normocytic, normochromic erythrocytes and serum iron was normal.

### (4) Hypochromic Anemia

This diagnosis was considered only in patients with a normal blood count and a persistent mild reduction in haemoglobin level that returned to normal levels soon after delivery.

#### 4) *Concurrent conditions*

Of the 1000 hospital births, an increased incidence of hypochromic microcytic anemia was observed in the bloodsmears of patients whose anemias did not respond to iron and (or) showed a good response, when this and iron was given in addition. Serum ferritin, and serum  $F_{65}$  levels were not measured in this series.

The relative incidence of the various factors responsible for anemia in 750 Negro patients whose hematoglobins at the third trimester of pregnancy was less than 10 g per 100 ml is shown in Table II.

Table II

Iron	34.1%
Possible fol. and deficiency	16.5%
Hypochromia	10.5%
$\beta$ thalassemia trait	7.9%
Chronic iron infection	5.5%
Displastic anemias	8.2%
	100.0%

Iron deficiency is thus the most important cause of anemia in pregnancy. There is an appreciable incidence of the  $\beta$  thalassemia trait, chronic iron infection and possible fol. and deficiency. It is possible that in some of the cases in which the diagnosis was uncertain, actual blood loss may have been the cause.

It is well established that dietary iron is barely sufficient to meet the requirements of pregnancy and deficiency is likely to occur if there is any additional predisposing factor. The incidence of several pre-disposing factors to iron deficiency was compared in anemic patients and non-anemic controls. In anemic patients, there was an appreciably greater incidence of menorrhagia before pregnancy, gastric antral disturbances, haemorrhoids and bleeding gums. It was found that the capacity of iron was less frequent in the anemic patients than in the non-anemic controls.

The hematoglobin concentrations of 2400 women were recorded in the SN Unit at the Ford Hocking Clinic. This group comprised 1326 British and 1074 Negroes with the following somewhat surprising results.

In British patients, 55.6 per cent had a hematoglobin concentration below 12 g/100 ml and 17.2 per cent below 10 g per 100 ml. In Negroes, patients, 49.1 per cent had a hematoglobin below 12 g per 100 ml and 14.4 per cent below 10 g per 100 ml. This confirmed an impression we have had that British women or Negro in any race exhibit a higher incidence of anemia in pregnancy than the Negroes.

#### RHESUS INCOMPATIBILITY

In Britain approximately 85 per cent of the population possess the Rh<sub>0</sub> antigen in their blood and therefore the incidence of Rh<sub>0</sub> negative persons in the population is about 15 per cent. As the Rh factor is approximately the incidence of the Rh<sub>0</sub> antigen

stages in many other communities, the incidence of Rhoeo-*recombinans* is 100%. A large carrier rate, only on the B, the Maltese Islands by the Rural Sanitation Service, and an additional 9 per cent of Rhoeo-negative patients was found.

Figures from our own unit confirm the above findings. An analysis of 4,000 patients showed an incidence of 54 per cent among Israeli women and 9 per cent among Maltese women. The incidence and problems associated with Rhoeo recombination among the Maltese community is correspondingly reduced. This is a factor which has to be taken into consideration when assessing the amount of anti-D immunoglobulin to be ordered for the community at the Maltese Islands.

#### THE GRAND MULTIPARA

There is a high incidence of grand multiparity in Malta. The pattern has changed since the 1950s, chiefly due to the decline in birth rate and, secondly, because grand multipara no longer offers the same grave difficulties, apart from the obvious standpoint which existed in the past. However, certain observations are undoubtedly more common in these cases.

A recent study was made in Malta of 838 grand multiparas of para 7 or over (classical PMs). These constituted 15.7 per cent of the total admissions for a two year period. Patients were mostly from the lower social strata and, although all had their deliveries in hospital, antenatal examinations were often erratic. The highest parity recorded was 22. The patient was aged 63 years and had a normal pregnancy and delivery.

The diastolic rate was high, until the reading was included all patients whose blood pressure was found to be above 140/90 or more than one occasion during the pregnancy. There were 142 cases, an incidence of 22.8 per cent. This is a high rate and is possibly related to the frequent separation of gross, abiding in the uterus, which together with glycosuria, forms almost a picture of anencephalic disease in this class of patient in Malta. Another possible factor for the high figure has been the difficulty in follow-up and treatment of hypertensive patients who refuse repeated treatment.

There were 13 cases of *abruptio placentae* in this group—an incidence of 2.63 per cent. Caesarean Section was performed in 40 cases—4.7 per cent of the series. Hysterectomy was performed in 5 cases, 3 cases for ruptured uterus and once for unmanageable bleeding during Caesarean Section in a stable case. The three cases of uterine rupture occurred in women who were para 7, 8 and 9 respectively.

There was 1 maternal death, an incidence of 0.15 per cent. This was a para 11 aged 58 who had a Caesarean Section for foetal distress, bled and died 5 days later from pulmonary oedema and heart failure. Thirty-seven cases of preeclampsia were recorded, an incidence of 5.6 per cent and the incidence rate was 3 per cent.

Multiparousness was common. There were 16 cases of breech presentation, an incidence of 2.1 per cent, 40 cases of breech presentation and 2 cases of foot presentation.

The series shows a higher than average rate of such obvious abnormalities as toxemia, *abruptio placentae*, stillbirths and malpresentations, but the maternal mortality was not appreciably affected. This lower finding is directly related to improved antenatal care with earlier recognition and treatment of abnormalities.

and more malnourished in Cansado Section. But this is not to claim that the gross *malnutrition* is the physical equal of the women of lower parity. These women are of a higher age group—75 per cent in this series were over 30 years of age, and their medical conditions such as hypertension and diabetes tend to be more widespread.

#### CEPHALO-PELVIC DISPROPORTION

The average Maldivian female is of smaller stature than her British counterpart. Women of height between 4' 9" and 5' 0" are relatively common, as also are those with true conjugates of less than 10 cm. In the years 1960-1968 inclusive, there were 62 definite cases of disproportion in our unit leading to operative delivery of which 16 were in Maldivian women. As the Maldivian only account for about one-third of our patients, this would appear to be a significantly higher incidence. Of these 62 cases, 38 were delivered by Lower Segment Caesarean Section and 2 by fairly difficult forceps delivery.

Study of the figures themselves on this island shows that the small stature of the average Maldivian does not lead to operative delivery as much as might be anticipated. A large number of women of height 4' 9" and 4' 10" deliver quite normally. The average birth weight in this island is about 7 lbs 5 oz. This would suggest that pelvic configuration is very often favourable and also that their obstetric performance is satisfactory. It is probably true to say that the Maldivian women of small stature will deliver normally more commonly than her British counterpart.

#### BEHAVIOUR IN LABOUR

There is little doubt that the Maldivian patient does not, generally, display the same reaction to labour as her British sister. She requires more patience and sympathy and undoubtedly causes more difficulty in management. This may be improved to some extent by efficient ante-natal preparation in the form of relaxation-classes but the more unco-operative patient is still very prevalent. Surprisingly enough this does not appear to have much effect on their obstetric performance, but it does considerably increase the strain on midwives and obstetricians. It also increases the number of general anaesthetics necessary, for forceps deliveries in lack of an operation precludes some forceps deliveries which could otherwise be performed under general block anaesthesia.

Our figures over the past five years suggest that there is a slightly increased incidence of post-partum haemorrhage and retained placenta in our Maldivian patients, but the numbers are too small to have any statistical significance.

#### POST PARTUM

In the postnatal stage better feeding would appear to be a dying art and there would appear to be little difference between the Maldivian and the British in this respect, the conclusion reached by Maldivian obstetricians in their urban practice.

There is no significant difference in other postnatal complications in our unit.



A marked relaxation in the official Church attitude towards abortion has been noted in recent years. This openness is not practiced as such in Italian civilian hospitals, but it has been found that if sound medical grounds for abortion are advanced, the co-operation of the Church in this matter is generally obtained. As a result, the operation has been practiced with increasing frequency in Italian hospitals in the past three to four years.

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## HYPERTERIC OXYGEN THERAPY IN THE TREATMENT OF GAS GANGRENE

By John F. Davis and James Yates

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Gas gangrene will continue to complicate war-related war injuries. Local and systemic effects of anaerobes are described and an aggressive regimen of therapy is proposed. The hospital results of such treatment are reported and the respiratory needs of hyperbaric oxygen, antibiotics, debridement and antibiotics are related. The biological significance of aerobic bacteria obtained in animal experimental are described.

### INTRODUCTION

The Royal Navy has a traditional interest in high pressure physiology and as the past few years the department of surgery at the Royal Naval Hospital, Haslar, has treated a number of severely injured land troops with hyperbaric oxygen (Fig. 1).

Case	Diagnosis	Response
1	PERIPHERAL VASCULAR DISEASE	Nil or Palliative
10	TRAUMATIC BICHARDIA	Conservation of Tissue Accelerated Healing
1	GAS GANGRENE	Decreasing Requirement for Tissue Conservation of Tissue
20	FROGGENIC INFECTIONS	Barbiturate Sedation Accelerated Healing

Fig. 1. Changes of response of 51 patients in hyperbaric therapy.

All the conditions treated were of special interest to Royal Naval Hospital, Haslar, gas gangrene, which has been reported recently, with increasing frequency in civilian practice (Black, Hansen and Charn 1960; Corbett and Marshall 1960) becomes a scourge in times of war.

In World War I Maffucci (1960) has stated the incidence of gas gangrene was probably the highest in history at 10-15 per cent with a mortality of 50 per cent.

In all theatres involving British troops since 1945 the incidence of gas gangrene has been low (Shelburne 1948; Whitley 1960 and Moffat 1960). During the Korean campaign, Latta (1950) serving in 85th Hospital Ship (later) saw only three

ation. It was predicted, among 1,000 wounded, that 500 would not survive. This was confirmed in the German campaign, although an additional factor was the uncontaminated nature of the soil.

The highly artificial conditions of Yaman took overwhelming Atlantic air superiority, permitting immediate casualty evacuation, may never be repeated and a limited medical and overwhelming available medical and auxiliary services could well produce conditions analogous to World War I, while the Royal Marines as an elite specialist force may not, a high casualty rate when taken, early surgical care may not be feasible. Such conditions predispose to gas warfare and the second point is of using human events as a historical (historically described) to night soil situation, will this it could (Fig 3).



Fig 3. A typical public life in the old. The old and new, 1940, 1941, 1942, 1943, 1944, 1945, 1946, 1947, 1948, 1949, 1950, 1951, 1952, 1953, 1954, 1955, 1956, 1957, 1958, 1959, 1960, 1961, 1962, 1963, 1964, 1965, 1966, 1967, 1968, 1969, 1970, 1971, 1972, 1973, 1974, 1975, 1976, 1977, 1978, 1979, 1980, 1981, 1982, 1983, 1984, 1985, 1986, 1987, 1988, 1989, 1990, 1991, 1992, 1993, 1994, 1995, 1996, 1997, 1998, 1999, 2000, 2001, 2002, 2003, 2004, 2005, 2006, 2007, 2008, 2009, 2010, 2011, 2012, 2013, 2014, 2015, 2016, 2017, 2018, 2019, 2020, 2021, 2022, 2023, 2024, 2025, 2026, 2027, 2028, 2029, 2030, 2031, 2032, 2033, 2034, 2035, 2036, 2037, 2038, 2039, 2040, 2041, 2042, 2043, 2044, 2045, 2046, 2047, 2048, 2049, 2050, 2051, 2052, 2053, 2054, 2055, 2056, 2057, 2058, 2059, 2060, 2061, 2062, 2063, 2064, 2065, 2066, 2067, 2068, 2069, 2070, 2071, 2072, 2073, 2074, 2075, 2076, 2077, 2078, 2079, 2080, 2081, 2082, 2083, 2084, 2085, 2086, 2087, 2088, 2089, 2090, 2091, 2092, 2093, 2094, 2095, 2096, 2097, 2098, 2099, 2100, 2101, 2102, 2103, 2104, 2105, 2106, 2107, 2108, 2109, 2110, 2111, 2112, 2113, 2114, 2115, 2116, 2117, 2118, 2119, 2120, 2121, 2122, 2123, 2124, 2125, 2126, 2127, 2128, 2129, 2130, 2131, 2132, 2133, 2134, 2135, 2136, 2137, 2138, 2139, 2140, 2141, 2142, 2143, 2144, 2145, 2146, 2147, 2148, 2149, 2150, 2151, 2152, 2153, 2154, 2155, 2156, 2157, 2158, 2159, 2160, 2161, 2162, 2163, 2164, 2165, 2166, 2167, 2168, 2169, 2170, 2171, 2172, 2173, 2174, 2175, 2176, 2177, 2178, 2179, 2180, 2181, 2182, 2183, 2184, 2185, 2186, 2187, 2188, 2189, 2190, 2191, 2192, 2193, 2194, 2195, 2196, 2197, 2198, 2199, 2200, 2201, 2202, 2203, 2204, 2205, 2206, 2207, 2208, 2209, 2210, 2211, 2212, 2213, 2214, 2215, 2216, 2217, 2218, 2219, 2220, 2221, 2222, 2223, 2224, 2225, 2226, 2227, 2228, 2229, 2230, 2231, 2232, 2233, 2234, 2235, 2236, 2237, 2238, 2239, 2240, 2241, 2242, 2243, 2244, 2245, 2246, 2247, 2248, 2249, 2250, 2251, 2252, 2253, 2254, 2255, 2256, 2257, 2258, 2259, 2260, 2261, 2262, 2263, 2264, 2265, 2266, 2267, 2268, 2269, 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FIG. 2 The effects of various enzymes on gas gangrene.

with most complex controls and a respiratory system of almost total air by dermally breathe in the Royal Naval Physiological Laboratory.

All workers note the rapidity with which some symptoms and signs disappear when treatment is commenced (Pitt et al. 1960, and Bannister et al. 1961). The reason is so rapid that it cannot be explained as purely histological lesions (Van Ussak, 1960 and MacLennan, 1961). Increased tissue oxygen tension will inhibit the growth of obligate anaerobes found in gas gangrene, but Bannister et al. (1961) has shown that proteolysis may be induced from wounds pronounced cured of the disease.

#### BACTERIOLOGY

Clostridia isolated from gas gangrene are usually classified into *aerofaeces*, *perfringens* and *botulinum* types. In addition each organism produces exotoxins which have both local and systemic effects. Simple classification into two types of organism does not fully explain the pathology of the disease and study of the action of toxins has helped to elucidate the role of hypobaric oxygen in the condition (MacLennan, 1961 and Brooker Smith, 1964) (Fig. 3).

*Clostridium botulinum* is all anaerobes producing exotoxins. *Leishman* C is the most potent toxin in this group and is the alpha toxin of CI Factor Type A.

*Thymolysin* destroys red cells necessary for the profound anaemia. *Collagenase* and *hyaluronidase* break down local tissue barriers and hasten the spread of infection. *Cla* is produced by anaerobic tissue making an enzyme *carboxypeptidase*. It erodes the fascial planes and opens up further areas to infection. Finally *proteolysin* erodes will partially necrotic muscle to produce the classical appearance of gas gangrene.

Van Ussak (1960) has shown by *in vivo* and *in vitro* methods that oxygen at a pressure of 7 ATA will inhibit the production of  $\alpha$  toxin. Other experiments indicate that  $\alpha$ -toxin is rapidly fixed by tissue. Russell Smith et al. (1960) suggested that haemolysis is inhibited by hypobaric oxygen. Hypobaric oxygen appears therefore to have an initial toxin-inhibitory effect and later haemolytic effect.

#### CLINICAL MANAGEMENT

On admission to the Royal Naval Hospital, Haslem, haemoglobin, where blood cell count, urea, electrolytes, liver function tests and blood gas analysis are carried out (Fig. 4). Wound swabs are taken and a full tissue X ray will often reveal gas in muscle planes.

#### INVESTIGATIONS

HAEMOGLOBIN  
WHITE BLOOD CELL COUNT  
LIVER FUNCTION TESTS  
UREA, ELECTROLYTES  
BLOOD GASES  
WOUND SWABS  
MUSCLE BIOPSIES  
(CREATININE PHOSPHOKINASE)

Fig. 4. Patient investigations in cases of gas gangrene admitted to RNL Hospital, Haslem.

With the exception of one fatal anoxemia, our three patients have been treated having been awake long enough to a time that well established gas programs requiring immediate correction of fluid, electrolyte and acid-base balance and replacement of red cell mass by fresh blood transfusion. A constant intravenous daily metabolic regimen of 48 bits of penicillin is commenced (Fig 5). The two most recent cases were also given a course of hydrocortisone.

#### TREATMENT

ELECTROLYTE and ACID-BASE CORRECTION  
INTRAVENOUS PENICILLIN  
HYPERBARIC OXYGEN at 3 ATA  
THOROUGH DEBRIDEMENT  
HAI-MOSTASS  
LIME SUPPORT and ELEVATION  
\* COBALTICIN  
BLOOD TRANSFUSION

Fig 3. Detailed treatment regimen for gas program cases.

Hyperbaric oxygen therapy is employed immediately after the diagnosis is made and before primary surgery. Patients are given twice daily therapy of 2½ hours' duration at 3 ATA and, in severe cases, 4 periods of such therapy may be required daily for the first 48 hours. The immediate and dramatic improvement in the condition then permits continued debridement, which must include draining the deep focus widely and ensuring all necrotic muscle. Haemostasis is essential to avoid bleeding on removal. The wound is left open and the limb elevated and supported. An operation wound reflex and muscle biopsy (Roth 1945) are taken.

#### RESULTS

Eight cases of gas gangrene have been treated in our Marine unit with one death. The six cases responded rapidly to hyperbaric therapy even when patients were in danger of 103°F and the pulse rate 140-160 a return to normal values could be observed within 48 to 72 hours (Fig 6). Brief histories of five of the cases (numbering of our eight cases of gas gangrene are given).

*Mr W.F.R. Age 18.* This case followed elective extension of the upper limb, was non-traumatic and delirious and became rational after his first exposure (Fig 7). Although infection had extended to a footplate a better knee amputation was possible.

*Mr P.J.B. Age 40.* Figure 8 shows a clean penetrating wound in a boy who had sustained a penetrating injury of the right limb. It is interesting because it was picked up early by an alert general practitioner who had worked in India and was not only early case. At operation the muscle appeared healthy, contracting when manipulated and bleeding when cut. A biopsy, however, showed stripping of the sarcolemma and some necrosis of the muscle fibres (Fig 9). Operations with a morphology identical to C. Welchii were found. On the basis of the evidence, hyperbaric oxygen therapy was commenced. The area was subsequently grafted and full function restored.

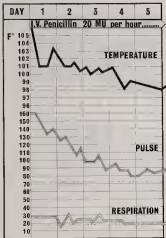


Fig. 4. A. Temp. of rectum in days 1 and 2; B. Temp. of rectum in days 3 and 4.



Fig. 1. Case D.B. Pre-operative view of the right arm.



Fig. 2. Case D.B. Post-operative view of the right arm following debridement. Gas present and *C. welchii* isolated.

*Male D.B. Age 35.* Another patient was admitted with gas gangrene following compound comminuted fractures of the ribs and limbs. The infection extended to the level of the mid thigh. Following massive debridement and hyperbaric oxygen therapy a through limb amputation was possible.



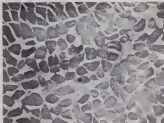


Fig. 2. Early post-operative muscle apparently divided in segments. Many myoblasts with nucleoli and of size 10-15  $\mu$ m and overlap of nuclei in a CTR fibre (top right, arrow).

**M-F B, Age 10.** An old man with an 8 day history of spontaneous pain and swelling of the limb who was sore, swollen and deeply shocked on admission presented the only death. Gross extensive hyperplasia occupied the only biopsy in enough for extensive dissection of the muscle muscle masses of his leg, thigh and abdomen after three days and it is necessary to note that, after ten days, dissection could no longer be achieved although histology and gross pictures presented in abundance. At post mortem the gross muscle was found necrotic, and liquefied. Hyperplasia suggests that you usually be exposed to cups with involvement of that order.

**M-F B, Age 10.** This patient presented with a heavy swelling of the left leg which had been explored in a regional hospital. He developed edema of the left thigh and anterior abdominal wall extending down the medial aspect of the thigh into the inguinal fossa and leg before being considered to our unit as a state of non-reversible haemorrhagic shock. Forty-eight Mls of intravenous penicillin were given daily together with an oral dose of 4 gms of hydrocortisone in a total dose of 40-60 gms. After ten days hyperplasia oxygen therapy. After 100 was dropped from the muscle compartments of the abdomen, back, thigh and leg, the deep fascia being opened widely (Fig. 10). An excellent result was achieved with preservation of life and limb and full leg movement (Fig. 11).

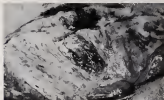


Fig. 10. Case 11. Necrotic area, *Streptococcus*/necrotic area.

In summary, these three different systems have been compared in the treatment of gas gangrene.

#### DISCUSSION

In the foregoing three reports are noted differences in susceptibility with aerobic and anaerobic with a difference provided the anaerobic (e.g., *C. difficile*) does not die; the efficacy of anaerobes is improved than for aerobic, i.e., streptococci and hyperbaric oxygen alone is no substitute for anaerobic wound debridement and extensive penicillin. However, very high blood levels should be maintained if anaerobes are to be effective (McCluskey and Jones, 1966) and large doses of penicillin have been given in case of the inadequate penicillin administered in the affected relatively ischemic muscle.

The one clutch in the series occurred before the general aggressive policy was introduced and may account for the persistence of non-diffusible organisms which were not destroyed by hyperbaric oxygen. In retrospect, debridement was too little and too late. It may therefore be argued that radical debridement and IV penicillin are adequate in themselves, but that is to ignore the initial effects of toxins which can only be cleared by hyperbaric oxygen, and we now make it our policy to give the first compression before debridement. In this connection it must be emphasized that neither oxygen therapy nor debridement will break delay and in fact for a positive culture of organisms whose morphology may be altered by antibiotics may spoil the difference between saving and losing a limb.



Fig. 21. Case 111. *P. aeruginosa* infection of the skin.

Then there is the role of antibiotics. The cardiovascular systems of young healthy patients and others may be able to cope with the initial infection but not that of older patients with depleted stored potential. The successful management of the old man with widespread endogenous infection who left hospital without medical disability may have owed a great deal to early massive steroid therapy and the difficulty of subsequent skin peeling following extensive debridement is a relatively minor problem in this connection. Finally, when is muscle damage irreversible? How is the state recognized and how critical might our interventions be?

To answer these questions, Figs. 12 and 13 show the extremes of the spectrum. First, the path endarteries inside of early gas gangrene reveal minimal small cell infiltration, swollen fibroblasts and early separation of the endothelium. At the other end of the scale, a gross fibrin haemorrhagic myonecrosis occurs after varying muscle

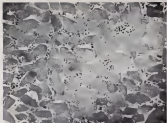


Fig. 10. *Staph. aureus*. Mixed culture of *Staph. aureus* and *Staph. epidermidis* (H&E).

Fig. 11. *Staph. aureus* (top) and *Staph. epidermidis* (bottom) (Gram stain).



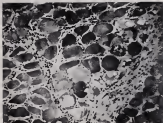


Fig. 14. *Zone necrosis of muscle (15x). Medial view distal to junction of jaw (arrow) (Fig. 13).*

break is half. Because these extremes (Fig. 14) a reversible stage of muscle damage occurs with vasodilation, some initial cell infiltration and early retraction of the fibrils from the sarcomeres. These muscle fibers should undergo the stages of recovery and initial decompression during the first and deep fascial split of the entire length of the limb between joints. The severe structure/plasticity stage level can, then, be determined whether debridement has been complete.

#### CONCLUSIONS

1. Gas gangrene remains a serious complication of contaminated war wounds.
2. Hypertonic oxygen, massive antibiotics, extensive surgical debridement and mechanical vacuum therapy provide the basis for successful treatment.
3. Muscle biopsy may provide positive evidence of gas gangrene as early as 48 hours before clinical muscle destruction occurs.
4. The usual lightweight, or portable, oxygen chamber should be available for the treatment of limb casualties.



## OXYGEN POISONING IN A HYPERBARIC ENVIRONMENT

By J. Marty Young

### ABSTRACT

The biochemical mechanism of oxygen poisoning are discussed together with the signs and symptoms produced clinically. Investigation of 19 subjects participating work (mean  $\dot{V}_{O_2}$  consumption 1.4 l/min) for 48 minutes in a pressure chamber at saturated depths of 20 to 47 feet of sea water showed that the degree of asoxia, markedly reduced the oxygen response tolerance of the subjects. This investigation also showed that rapid decompression of subjects breathing oxygen can produce an exacerbation of existing symptoms and these results are discussed.

It is stressed that any breathing mixture containing a partial pressure of oxygen in excess of 1960 mm constitutes an environment which is hazardous with respect to oxygen and oxygen is added to the administration of oxygen to any patient.

Pure oxygen has been viewed with suspicion since its initial discovery and Parry (1773) said: "though pure dephlogesiated air might be very useful in a medicine it might not be so proper for us as the usual healthy state of the body. For as it would burn our flesh faster as dephlogesiated air than as common air, so we might as may be said, burn out our life; and the animal powers be too soon exhausted in the pure kind of air."

It was soon shown that animals did not have any marked changes in their metabolism even when subjected to moderately mixed  $O_2$  tensions and Schmidt (1902) found that growing plants showed retarded development at 75 per cent of an atmosphere of oxygen.

It was not however until Paul Bert published the results of his experiments in *La Pression Barometrique* (1878) that the full significance of  $O_2$  poisoning was realized. All research since then has suggested that  $O_2$  is probably toxic to the cells of all organisms.

Many investigations have been performed into the biochemical and clinical aspects of the problem of  $O_2$  toxicity, but no solution has yet been found. Although limited protection against the toxic effects has been obtained in animal models. The earlier work is well reviewed by Stollé, Rags and Hargrave (1944) from (1942) Bickart (1944) and Becker Freysong and Charnov (1955) and the current position of our chemical knowledge is fully described by Hargrave (1964).

### Biochemical effects of oxygen

The exact mechanism of  $O_2$  poisoning is not understood, but in some experiments show that increased tensions of  $O_2$  produce alterations of cellular metabolism and inhibition of enzyme systems, and it is probable that these changes occur as are before any clinical signs of toxicity appear. The metabolic reactions that are particularly susceptible to  $O_2$  are concerned with carbohydrate metabolism and energy

transfer and involve compounds which contain essential endphytyl groups, eg. cyanogen such as hydrogen and cyanogen. A cyanogen such as cyanide inhibits protein synthesis, i.e. reduces and prevents end decarboxylation. There is also evidence that cellular membranes and the structure of mitochondria may be damaged by lipid peroxidation and that other toxic components such as glutathione may be involved. There is great variation in the sensitivity of different tissues to  $\text{O}_2$  and in man, the sensitivity is in the descending order of brain (brain, liver, lung and muscle) (Lodges *et al.* 1965).

Most of the biochemical investigations have been *in vitro* but Dawson, Lodges and Van Den Broek (1966) demonstrated a reduction in the concentration of endphytyl groups in lung tissue at about rates that depends on 5 mm.  $\text{O}_2$  for 48 hours. The inhibition of glutathione and decarboxylation has also been demonstrated *in vivo* as well as *in vitro* (Schacter *et al.* 1962) and the product of the reaction of the cyanogen,  $\gamma$ -aminobutyrate and  $\text{Co}^{2+}$  (S.A.) is lower in the brains of rats after exposure to high pressures of  $\text{O}_2$  (Wood, Winters and Clydesdale 1961). Hargrave (1965) therefore states that 'the studies of oxygen poisoning *in vivo* have provided strong support for the hypothesis that oxidation of endphytyl groups of important tissue components plays an important role in the production of the symptoms of oxygen toxicity *in vivo*'.

Dawson and Hargrave (1964) stress that it has not yet been possible to discover any effect on an isolated enzyme system which occurs with sufficient rapidity to explain the time of onset of the convulsive symptoms associated with  $\text{O}_2$  poisoning in intact animals. It has, however, been found that the degree of inhibition of any enzyme depends to a great extent on the conditions of the experiment and is influenced by antioxidants, metal ions and coenzymes which normally occur intracellularly. It is therefore possible that the speed of a reaction *in vivo* may be much altered from that demonstrated *in vitro*.

#### Oxygen and Symptoms of $\text{O}_2$ Poisoning

The degree of toxicity produced by  $\text{O}_2$  is related to the initial exposure with regard to both time and partial pressure ( $P_{\text{O}_2}$ ) and the clinical symptoms can be divided into two main groups, those that are primarily associated with the central nervous system, and those that are more noticeable in the respiratory system.

Symptoms associated with the central nervous system were first described by Paul Bert (1876) and are brought about by exposure to high pressures of  $\text{O}_2$  for times measured in minutes. This acute  $\text{O}_2$  poisoning was prevented by divers and tunnel workers in the past and now affects patients undergoing treatment in the current regime of hyperbaric  $\text{O}_2$  therapy.

Pulmonary symptoms were first noted as an irritation by Brantley (1775) and gave rise to the usual suspicion that  $\text{O}_2$  may burn up the lungs. Lorenz Smith (1889) more fully described the symptoms, which occur in subjects experiencing  $\text{O}_2$  pressures of up to 4 atmosphere for times measured in hours or days. Patients on artificial respiration and on  $\text{O}_2$  tents are among those who might experience 'pulmonary'  $\text{O}_2$  toxicity.



**"Acute"  $O_2$  Poisoning**

The signs and symptoms of "acute  $O_2$  toxicity were fully described by Donald (1946 and 1947) and are summarized in Fig. 1. The symptoms are interdependent.

**SYMPTOMS OF "ACUTE" OXYGEN POISONING**

Early	Later
FACIAL PALOR	HIBELLATION OF FACIAL MUSCLES
SWEATING	TWITCHING OF FACIAL MUSCLES
BRADYCARDIA	SEVERE NAUSEA OR VERTIGO
NAUSEA	RESPIRATORY DISTURBANCES
VERTIGO	ABNORMAL MENTAL STATES
VISUAL DISTURBANCES	DILATION OF PUPILS
FATIGUE	CONVULSION

Fig. 1

either directly or on EEG, from grand mal epilepsy (Shover, Downes, Muenich and Wilkins, 1944; Cohen and Garb, 1945) and many of the preliminary symptoms are similar to those experienced on the onset of epileptic epilepsy (Donald 1946). There is marked variability in the tolerance to  $O_2$  both between different subjects and in the same subject from day to day and occasionally a convulsion can occur without any preceding symptoms.

Some of the factors known to affect  $O_2$  tolerance are shown in Fig. 2. The following

**FACTORS AFFECTING OXYGEN TOLERANCE**

Decreasing	Increasing
CARBON DIOXIDE	HYPERVENTILATION
EXERCISE	REST
"WET"	"DRY"
AGE	HYPOHEMIA
GENERAL DEBILITY	ANESTHESIA

Fig. 2

lengths shown by these factors can be illustrated by the fact that a pressure equivalent to 66 feet of sea water very rarely causes symptoms in subjects at rest or on  $O_2$  respiration without breathing apparatus in a dry environment (Lamberton, 1931) whereas the recommended safe depth for Royal Navy divers, swimming with  $O_2$  apparatus at the rate of only 25 feet.

**Effects of exercise on "acute" poisoning**

The effect of hard work on the  $O_2$  tolerance of subjects using breathing apparatus in dry conditions at a pressure, standard has been reported elsewhere (Fleming, 1931). The subjects were volunteers from the Portsmouth City Fire Brigade and in all 192 experiments were performed, involving the exposure of 25 subjects to standard depths of between 20 and 47 feet (2.9 to 16.4 mg).



Fig. 1. Views of inside of pressure chamber. Subject on left wearing helmet and  $O_2$  mask. Subject on right wearing helmet and  $O_2$  mask.

Fig. 1 shows one of the subjects in the chamber. They wore their full headlighting system, and used a closed-circuit  $O_2$  breathing apparatus (Protek Mk IV, Bako valves and Co Ltd), the total weight of their equipment being 37½ lbs (16.9 kg). They performed a constant maximal routine which was designed so that the subjects could approach exhaustion by the end of the 40 min experiment. The exercise consisted, in part, of moving the subjects' own body weight and so was not constant for all subjects, but as the exercise was standardized each subject acted on his own control. The mean  $O_2$  consumption for the 40 min period for all the subjects was 3.4 l/min.

The clothing worn by the subjects was thick and non-wearable so that substantial heat in their body temperature occurred. The deep body temperature was monitored with a rectal pill (Electrona, Endotermic Limited) in 23 subjects using an aerial in the chamber and a receiver outside (Fox, Goldsmith and Wolff 1961). Over the 40 min exercise period the mean increase was 1.3°C. The weight loss of each subject was measured for each experiment and the mean loss was 21.4 or 9.73 kg.

The inspired and end-tidal  $CO_2$  values were measured continuously in one subject at each experiment and the results showed that there was little tendency toward  $CO_2$  retention in spite of the high resistance of the breathing apparatus. The

hyperoxygenation brought about by the increase in deep body temperature (Belmont 1958) would have resulted in maintaining normal and undisturbed  $\dot{V}_{O_2}$  values.

The  $\dot{V}_{O_2}$  concentrations of the subjects' inspired gas was measured and found to have a mean value of 16.6 per cent, this low figure being caused by the difficulty of obtaining the breathing set of 45 cm fully contained air. In the investigation at 47 feet the subjects were warned to finish through their nose more thoroughly before the ascent and the mean  $\dot{V}_{O_2}$  concentration of these experiments was 19.2 per cent.

The subjects were closely observed from both inside and outside the chamber and subjective and objective signs and symptoms were noted. Fig. 4 shows the

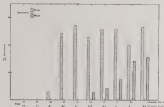


Fig. 4. Absence during the percentage of subjects having signs or symptoms at various depths.

results with the percentage of symptoms on the outside and recorded depth to first along the ascent. The depths are given in two places, the first being the actual depth at which the experiment was conducted. The second, which I have called the "oxygen depth" is the depth at which the subjects would have found themselves had they been breathing 100 per cent  $O_2$  in order to experience the same inspired  $P_{O_2}$  as they did at the actual depth breathing 16.6 per cent  $O_2$  (19.2 per cent at 47 feet). The predominant sign was a fine fibrillation of the muscles and incoherence, most commonly being mentioned by the subject, and this is in agreement with the findings made of Donald (1944) when he observed subjects who were undertaking hard work underwater. During the current investigation the chamber was filled with compressed air and so it was not to allow the subjects to associate with the hyperoxygen beyond the first appearance of lip twitching. It was found that subjects could continue working without any decrease in capability and finish the 45 cm reserve period as

spots of the feet than when the leg movements appeared within 3 minutes of the start of the exercise. These spots, together with very slight degrees of nausea or momentary dizziness, were observed in minor and from 25 to 40 ft.  $O_2$  depth onwards remained fairly constant within the 40-50 per cent range.

The first major symptoms occurred at 26 to 30 ft.  $O_2$  depth. The symptoms observed in major were severe nausea, lightheadedness and dizziness and extreme fatigue, definite loss of the pupils, euphoria, confusion and on rare occasions a vertiginous upsurge. The incidence of these symptoms appeared to be still increasing at the maximum depth reached during the series.

The minor symptoms were on the whole so slight that it is possible that they would not have been visible to observers in an unfamiliar environment and that were noted only by the subjects and so could not be ignored. It is therefore concluded that the major symptoms most closely correspond to the symptoms seen by previous observers. It also ties the effect of nausea to an  $O_2$  consumption of 1.4 l./min. had being in volume the  $O_2$  volume exposure of these subjects from the 30 feet for 2 hours, even in moving subjects is the same order as the 27 feet for 40 min. with a speed down.

#### Effect of decompression on "acute passing"

During the above investigations, on 79 occasions involving 124 subjects, de-compression was carried out at either 20 feet/min. or 60 feet/min. while the subjects were still breathing  $O_2$ . On 23 occasions (33 per cent) an exacerbation of already existing signs was noted soon after the start of decompression. One of the two convulsions occurred after decompression when the subject had taken off his apparatus and returned to a more normal  $P_{O_2}$ . This effect has been noted previously in both animal experiments and clinical hyperbaric  $O_2$  exposures and has been termed the "all effect" (Benn 1943; Proctor and Churchill-Stanley 1945; Van Den Broek 1954; Gahan 1954).

The cause of the exacerbation is uncertain but is usually attributed to a change in  $P_{O_2}$ . In these investigations the increase in signs occurred usually within 2 min. of the start of decompression which was shorter than the probable hang-time contribution made in these subjects, so the exacerbation was unlikely to have been caused by a change in control  $P_{O_2}$ . The other events which accompany decompression in a chamber are more cooling, air movement and clothing, but the exacerbations occurred before the clothing and any perceptible temperature change. Sudden loud noises never had any effect on the symptoms of the subjects, and on a few occasions the gas inlet and exhaust valves were opened simultaneously to provide noise and air movement while remaining at a constant depth but this manoeuvre also did not produce exacerbations.

Records have been collected from eight centres in the country as part of a survey of the clinical incidence of  $O_2$  toxicity in hyperbaric chambers. The incidence of convulsive episodes is 1.4 per cent of patients and 0.1 per cent of all exposures. Of these convulsive episodes 40 per cent have occurred at the start of, or during a planned decompression and that emphasizes the need for special care during the part of a therapy. The extreme giletal spasm which occurs during a reduction

prevention from risk of pulmonary haemorrhage and air embolism (decompression) is not entirely immediately.

It is recommended therefore that a hyperbaric  $O_2$  therapy would best be initiated by maintaining a constant chamber pressure and slowly decreasing the inspired  $PO_2$  of the patient until air breathing had been accepted out for at least a minute. This measure would lessen the risk of producing acute  $O_2$  poisoning and decompression could then be carried out at the normal rate.

#### 'Pulmonary' $O_2$ Poisoning

The symptoms of 'pulmonary' oxygen poisoning first appear after an exposure of the order of 1 atmosphere of  $O_2$  for 14 to 24 hours (Lushington, 1933) and are most noticeable in the respiratory system, being usually a substernal pain on deep inspiration and a dry cough and then a slowly progressive dyspnoea and eventual cyanosis.

However, animal experiments have shown that many other organs of the body are also affected by a similar exposure to oxygen (Dewar and Dewar, 1944).

Recurrent fibrosis of pleural tissue has been recognized for some time as a complication of these symptoms in man (Price, 1931) but the equally serious risk of  $O_2$  poisoning at levels of  $O_2$  much more widely recognized. Previously the efficacy of  $O_2$  therapy and there was no less than nearly every patient subjected to more than 40 per cent  $O_2$ , but higher partial pressures are now being administered with positive pressure apparatus. Cases have been reported of patients with steadily increasing central hypoxaemia in spite of treatment at a atmospheric pressure with 100 per cent  $O_2$  (Dumas, Roussier-Cabot and Rocher, 1946) and even with hyperbaric  $O_2$  therapy (Fyson, 1953).

A series of six cases has been reported (Schwartz, Charles and Martin, 1955) in which patients died with normal  $O_2$  tensions of the order of 50 torr despite administration of 100 per cent  $O_2$  at atmospheric pressure. All the cases had substantial prolonged death during their illness and the pathological findings in the lungs are probably influenced by the effects of extensive transfusion. However, in addition to pulmonary oedema, intra-alveolar haemorrhage and patchy infarction, there was a well marked hyaline membrane coating the alveolar rim and ducts and the smaller bronchioles. This hyaline membrane was only seen in cases in which prolonged  $O_2$  therapy had been given and similar membranes have been reported in animal experiments (Dumas, 1954). Spencer et al. (1951) it was therefore concluded that the  $O_2$  therapy was associated with the appearance of the hyaline membrane and contributed directly to the death of the patients by progressive alveolar-capillary block.

#### CONCLUSIONS

The reactions of the synthesis of oxygen poisoning is still not known although there is much evidence that the reactions of many enzyme systems, especially those that involve sulphhydryl groups, are altered in the presence of increased partial pressures of oxygen.

It has been shown that increasing markedly decreases the tolerance of subjects exposed to oxygen at a pressure of 3 Atm for 40 minutes. It was also shown that

decompression in natural atmospheric pressure while still breathing oxygen, thus such an exposure was likely to cause an exacerbation of the symptoms of the gas poisoning and the ensuing asphyxia (previous reports in the literature). It is therefore recommended that a hypertoxic oxygen therapy would best be terminated by means of the patient in a constant chamber pressure and slowly decreasing the inspired partial pressure of oxygen until no breathing has been carried out for at least a minute.

Finally, it should be stressed that any breathing system which contains a partial pressure of oxygen in excess of 180 mm constitutes an environment which is hypertoxic with respect to oxygen. In view of the long term effects of moderately increased oxygen tension and the risk of oxygen poisoning should always be considered during its administration in any patient.

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## FACTORS GOVERNING TECHNIQUES OF GASTRIC OBRAINAGE

By James Watt

### ABSTRACT

Peptic ulceration is a major problem in the Royal Navy and the role of bariatric or high-bariatric surgery greatly depends on normal physiological and anatomical requirements in operations designed for the outcome. Current surgical techniques tend to take account of the complex anatomical and physiological mechanisms of the gastro-duodenal problem. The results of studies of the blood supply and dynamics of the gastro-duodenal junction are reported and the techniques of three new gastro-duodenal drainage procedures are described.

Dyspepsia and associated peptic ulceration result in the annual loss of a significant proportion of the Navy's manpower. The size of the problem may be judged from hospital admissions for the years 1984 to 1985 when a total of 3 596 naval patients were investigated for dyspepsia. Of these 1 916 had a proven duodenal ulcer. No case was found for the dyspepsia in 1 683 cases and 2 742 had evidence of gastritis or duodenitis. While admissions for non-ulcer dyspepsia fell during this period, no doubt reflecting the improving standards of ship habitability and naval medicine as well, the incidence of peptic ulceration remained close correlation with the strength of the Navy (Fig 1). In five places, the number of ulcer cases involved appears to follow the overall incidence of peptic ulceration (Fig 2) but consideration of the percentage of ulcer cases involved reveals no discernible pattern and is probably dependent upon the outlook of hospital clinicians handling most of these cases.

The size of providing a patient high and wide is so essential that a degenerated round dyspepsia is of little value in the Service and a poor condition for surgery. The percentage of cases of proven ulceration referred to surgeons remains at about 18 per cent, including cases presenting as varicose oesophagus with perforation. But including the complications of haemorrhage.

In the post-war years and right up to the following years of the younger age group "Malmgren and Harrison (1949) reviewing the results of a one year follow-up of the medical treatment of 687 cases in Sweden concluded that "medical ulcer therapy in the accepted form has resulted in almost complete failure". In 1963, Krusen reported a 15 year survey of 465 peptic ulcer patients confirmed these conclusions and found that only 11 per cent of male patients had needed reoperation.

Blumen and Lewis (1966), both physicians, provided the first comprehensive review of the course of peptic ulceration among the Israeli population and advanced more frequent and earlier surgery and this was at a time when the Navy gastroenterology carrying a significant mortality in the hands of surgeons across the country was the operation of choice.



The reluctance of physicians to refer patients for surgery is understandable, since however excellent the quality of the results, a good hands-on operation is inherently difficult, sometimes and physiologically unsettling, and to a small number of cases associated with mechanical and long-term metabolic problems. Nevertheless, after consulting from the Service, the young adult patients' work and investigations has revealed that these cases are often referred to the general busy surgeon who often uses a standard technique—perhaps with minimal investigation—is a thorotomy on the best patients of the individual and the Service to control the ulcer dyspepsia on the grounds of age alone.<sup>1</sup>

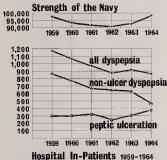
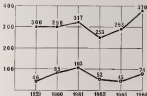


Fig. 1 The Army of Hospital In-Patients

Mainly surgical treatment ought to offer all mortality and a permanent cure, without surgery, but these claims have never yet been made for any condition. Happily, however, there now exist no acceptable alternatives to gastroscopy for duodenal ulceration, and surgery with gastric drainage as well as antacid rules only



●—● All cases of peptic ulceration

○—○ Cases invalidated

FIG. 1. *United Kingdom Association of Gastroenterologists*

upwardward operation provided that certain basic technical considerations are understood and practised. Nil mortality was achieved by the York/London group in operations upon 287 male patients (Cuthbert *et al.* 1964) and we have had no mortality from over 300 operations for peptic ulceration at the Royal Naval Hospital, Haslar. However, while again the large majority of patients do well, a small minority exhibit distress or long term sequelae—gastro-oesophageal dumping, recurrent ulceration, oesophageal diverticula and occasional malabsorption.

They have been attributed to the disorders of motility resulting from division of vagal efferents (Palace, Engelbrecht, Kinsman, Bunker and Johnson 1967), division of vagal afferents which comprise 90 per cent of the abdominal vagal fibres (Angelos, Charnock, Daly and McIntyre 1957) causing deranged physiological responses or disorders related to the type of drainage procedure employed.

Gastro drainage procedures (Fig. 2) may by-pass the duodenum or retain the duodenum in the circuit, either by an operation designed to divide the muscle ring responsible for postprandial obstruction, or by resection of the portion producing nausea and narrowing the narrowed stomach to the duodenum. The latter gives the lowest incidence of recurrent ulceration but involves the hazards of gastric resection and poses the problem of a stomach governed by the division of a duodenum often the seat of fibrosis. Pyloroplasty, on the other hand, is open to its duodenal



Fig 3. Gastric cancer procedures employed at Sydney.

operation both to provide permanent and repeatable results and, in a third, that has the highest incidence (30 per cent) of post-operative upper diarrhoea (Lew, Spence and Taylor, 1955).

The alternative to a gastroduodenal procedure is gastropexy, which causes the highest rate of recurrence (3.4 per cent) and post-operative vomiting (3.3 per cent, Fig 4). This makes it unacceptable for the authors. Moreover, the complications of a gastroduodenal anastomosis may rarely be managed at one by a medical consultant but this cannot be said for the complications of gastropexy.

	VAGOTOMY		
	Pyloroplasty	Gastrojejunostomy	Antrectomy
	%	%	%
EPISODIC DIARRHOEA	20.3	14.7	14.7
RECURRENT	5.3	5.6	0.8
MODERATE VOMITING	5.9	13.6	—

Fig 4. Comparison of post-operative sequelae following the three procedures at Sydney, 1955.

Since girdler drainage for the neural plexus runs probably in a postobesophageal position, we are uncertain the lack of draining why it failed to produce consistently good results and how it might be improved.

#### Anastomosis Pylorus

The design of such operations used tells into various anastomosis pyloroduodenum and physiological responses of the normal pyloroduodenal canal. In a study of the comparative anatomy of this region, Torgerus (1942) convincingly demonstrated a broad smooth muscle pylorus, subject to spasm, venous (Fig. 5).

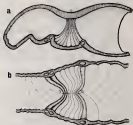


Fig. 5. Diagrams of pyloroduodenal junction (Torgerus). (a) is state in which pylorus is contracted and (b) is state in which pylorus is relaxed.

In man, the inner circular layer of the pyloric channel descends a series of loops acting as an interlocking, relatively smooth constriction of fibers on the lesser curve which descend, stabilizes the canal around the nodule, greater curve and irregularly distributed throughout the pyloric canal between two constrictions, of circular fibers, the lower in the proximal end of the canal, the more obvious at the pylorus that constriction for the peristaltic passage seen in radiopaque shadows in deep indents, most of the greater curve in the area and passing inward, proximal of pyloric constriction with uniform pyloric gastric folds. Torgerus suggests that a distal constriction to the pyloric sphincter is probably there in pyloric distal pylorus.

celum. The studies of Baranpuri (1943) showing the closure at the pyloric sphincter before the termination of the peristaltic wave appear to substantiate this.

The longitudinal muscle arrangement is equally patterned. On the lower curve, a long pyloroduodenal band acting like a ligum coli, shortens and then the lesser curve while on the greater curve the pyloric and duodenal poroses are separately inserted into the contractile annular ring between the duodenal and pyloric constrictions of the circular muscle sphincter thus holding open the peritoneal cavity for the second period.

Obviously, no reaction or movement but any of the muscular rearrangement of modern pyloroplasty procedures can hope to reconstruct the balanced muscular mechanism and operations causing gross distortion will lead to abnormal peristalsis and altered rhythm-patterns. Frank (1955) has shown that, at any case, the initial duodenal pressure is slightly higher than the gastric pressure and the gastric stream which follows rapidly more considerably dilates gastric trapping, particularly, when deformity and obstruction are present at the new position or movement. Shuttle (1967) using radio-coastal barium capsule and Davies, Griffith, Owen and Shields (1968) using a Chromium M. scanning technique have shown that this occurs in vivo.

The relationship of the duodenum to the normal lumbar lordosis must also be remembered. The first part of duodenum curves around the right side of the lumbar bodies to become the second part which descends along the right para-aortic part (Fig. 4), the third part crossing the lumbar spine soon more to become the fourth part. Operations which alter these relationships may influence gastrointestinal dynamics.

#### Gastric dynamics

The flow of gastric chyme through the pyloroduodenal canal is of vital import.



Fig. 5. Transverse section of abdomen at level of L4/L5.

analogous to the flow of blood through a main artery and, although not pulsatile in direction, Belsey<sup>11</sup> has shown that gradual narrowing such as occurs in the normal pyloric canal will not affect luminal flow which, by providing a slow moving peripheral stream, may play an essential part in distributing evenly the digesta loads over the duodenal mucosa. Short constrictions may result in turbulence and affect these phenomena (Fig. 7). They may appear in the control channel of several



Fig. 7. Turbulence due to constricting such as a duodenal stenosis.

pyloroplasties (Fig. 8) as is the result of stenosis of the circular muscle layer of anastomosis. The Reynolds number is probably relevant and represents a figure derived from a combination of factors to determine a point above which turbulent flow may occur.

All duodenal tubes like the Stockman are governed by the law of Laplace (Fig. 9) which states that tension in the wall is proportional to the product of its radius and the pressure in the lumen and contractions causing turbulence and fall in chyme pressure may influence duodenal return and clearance.

Valvular overloads of gastric emptying following gastrojejunostomy suggest to indicate that the food needs time to pass on with luminal flow (Fig. 10) and a normally distensible proximal duodenum probably containing a peristaltic capable



Fig. 4. Anatomic view of the duodenum and the pancreas.

## CHYMODYNAMICS

### REYNOLDS NUMBER

$$Re = \frac{VDd}{\mu} \quad \text{where } V = \text{Chyme velocity}$$

$$D = \text{Duodenal diameter}$$

$$d = \text{Chyme density}$$

$$\mu = \text{Chyme viscosity}$$

### LAPLACE'S LAW

$$T = P \times r \quad \text{where } T = \text{Duodenal wall tension}$$

$$P = \text{Chyme pressure}$$

$$r = \text{Duodenal radius}$$

Fig. 4. Anatomic view of the duodenum and the pancreas.

of establishing the pattern of individual persistence. Perhaps we ought to consider, in this discussion, the field as another type of vegetation, or rather:



1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28 29 30 31 32 33 34 35 36 37 38 39 40 41 42 43 44 45 46 47 48 49 50 51 52 53 54 55 56 57 58 59 60 61 62 63 64 65 66 67 68 69 70 71 72 73 74 75 76 77 78 79 80 81 82 83 84 85 86 87 88 89 90 91 92 93 94 95 96 97 98 99 100 101 102 103 104 105 106 107 108 109 110 111 112 113 114 115 116 117 118 119 120 121 122 123 124 125 126 127 128 129 130 131 132 133 134 135 136 137 138 139 140 141 142 143 144 145 146 147 148 149 150 151 152 153 154 155 156 157 158 159 160 161 162 163 164 165 166 167 168 169 170 171 172 173 174 175 176 177 178 179 180 181 182 183 184 185 186 187 188 189 190 191 192 193 194 195 196 197 198 199 200 201 202 203 204 205 206 207 208 209 210 211 212 213 214 215 216 217 218 219 220 221 222 223 224 225 226 227 228 229 230 231 232 233 234 235 236 237 238 239 240 241 242 243 244 245 246 247 248 249 250 251 252 253 254 255 256 257 258 259 260 261 262 263 264 265 266 267 268 269 270 271 272 273 274 275 276 277 278 279 280 281 282 283 284 285 286 287 288 289 290 291 292 293 294 295 296 297 298 299 300 301 302 303 304 305 306 307 308 309 310 311 312 313 314 315 316 317 318 319 320 321 322 323 324 325 326 327 328 329 330 331 332 333 334 335 336 337 338 339 340 341 342 343 344 345 346 347 348 349 350 351 352 353 354 355 356 357 358 359 360 361 362 363 364 365 366 367 368 369 370 371 372 373 374 375 376 377 378 379 380 381 382 383 384 385 386 387 388 389 390 391 392 393 394 395 396 397 398 399 400 401 402 403 404 405 406 407 408 409 410 411 412 413 414 415 416 417 418 419 420 421 422 423 424 425 426 427 428 429 430 431 432 433 434 435 436 437 438 439 440 441 442 443 444 445 446 447 448 449 450 451 452 453 454 455 456 457 458 459 460 461 462 463 464 465 466 467 468 469 470 471 472 473 474 475 476 477 478 479 480 481 482 483 484 485 486 487 488 489 490 491 492 493 494 495 496 497 498 499 500 501 502 503 504 505 506 507 508 509 510 511 512 513 514 515 516 517 518 519 520 521 522 523 524 525 526 527 528 529 530 531 532 533 534 535 536 537 538 539 540 541 542 543 544 545 546 547 548 549 550 551 552 553 554 555 556 557 558 559 560 561 562 563 564 565 566 567 568 569 570 571 572 573 574 575 576 577 578 579 580 581 582 583 584 585 586 587 588 589 590 591 592 593 594 595 596 597 598 599 600 601 602 603 604 605 606 607 608 609 610 611 612 613 614 615 616 617 618 619 620 621 622 623 624 625 626 627 628 629 630 631 632 633 634 635 636 637 638 639 640 641 642 643 644 645 646 647 648 649 650 651 652 653 654 655 656 657 658 659 660 661 662 663 664 665 666 667 668 669 670 671 672 673 674 675 676 677 678 679 680 681 682 683 684 685 686 687 688 689 690 691 692 693 694 695 696 697 698 699 700 701 702 703 704 705 706 707 708 709 710 711 712 713 714 715 716 717 718 719 720 721 722 723 724 725 726 727 728 729 730 731 732 733 734 735 736 737 738 739 740 741 742 743 744 745 746 747 748 749 750 751 752 753 754 755 756 757 758 759 760 761 762 763 764 765 766 767 768 769 770 771 772 773 774 775 776 777 778 779 780 781 782 783 784 785 786 787 788 789 790 791 792 793 794 795 796 797 798 799 800 801 802 803 804 805 806 807 808 809 810 811 812 813 814 815 816 817 818 819 820 821 822 823 824 825 826 827 828 829 830 831 832 833 834 835 836 837 838 839 840 841 842 843 844 845 846 847 848 849 850 851 852 853 854 855 856 857 858 859 860 861 862 863 864 865 866 867 868 869 870 871 872 873 874 875 876 877 878 879 880 881 882 883 884 885 886 887 888 889 890 891 892 893 894 895 896 897 898 899 900 901 902 903 904 905 906 907 908 909 910 911 912 913 914 915 916 917 918 919 920 921 922 923 924 925 926 927 928 929 930 931 932 933 934 935 936 937 938 939 940 941 942 943 944 945 946 947 948 949 950 951 952 953 954 955 956 957 958 959 960 961 962 963 964 965 966 967 968 969 970 971 972 973 974 975 976 977 978 979 980 981 982 983 984 985 986 987 988 989 990 991 992 993 994 995 996 997 998 999 1000 1001 1002 1003 1004 1005 1006 1007 1008 1009 1010 1011 1012 1013 1014 1015 1016 1017 1018 1019 1020 1021 1022 1023 1024 1025 1026 1027 1028 1029 1030 1031 1032 1033 1034 1035 1036 1037 1038 1039 1040 1

FIG. 11. Composite diagrams of  $\rho$ 's military and military activities.



### Physiological Factors

The regulation of gastric secretion and control of gastric emptying depend to a great extent upon the integrity of the duodenum. Fig. 11 attempts to show some of the complex mechanisms involved. Acid receptors in the pyloric antrum (Winnick and Lynn, 1960; and Draggott (1954) and duodenal (Clegg, 1957) receptors tend to act at low pH, suppressing the production of gastric acidity by short neuronal and long vagal pathways. Duodenal mucosceptors were similarly to those of high sensitivity (Hunt, 1956) and lie at the plexus of the enteric liberation of the blood-borne duodenal hormones enterogastrone, (Bollaguer and Woodward, 1955) for this purpose. The net mechanical stimulation of the sensory and detection of the stomach are constantly and even cause only a minimal voluntary effect by means of its sensory, gastric. It is evident that any mechanical or physiological barrier to normal gastric emptying may threaten gastric secretion and lead to mucous abrasion in spite of vagotomy. A good duodenal blood supply and intact mucosa are obviously of high importance.

### Status of Blood Supply

Since an adequate, description of the blood supply of the duodenum could be found, we prepared an illustration (Fig. 12) of the stomach, duodenum and pancreas.



Fig. 12. A schematic diagram of the human stomach, duodenum and pancreas.

and segmented in 10  $\mu$ m sections, mounted with mounting paper (100  $\mu$ m  $\times$  100  $\mu$ m  $\times$  0.5 mm) and subjected to long air-drying, vacuum exposure at 37 K for 24 h at a distance of 30 inches and using Kodak high resolution screen, and rapid processing. Fig. 12 shows the splenic artery supplying the body and tail of the pancreas and the fundus and body of the stomach via the short gastric vessels which anastomose with branches of the left gastric artery.

The gastroduodenal artery was then filled (Fig. 13). Branches supply the head of the pancreas via the anterior and posterior pancreaticoduodenal vessels, each providing segmental vessels for all except the proximal 2.5 to 3 cm of duodenum. The right gastropyloric branch is well filled to complete the arcade on the greater curvature.

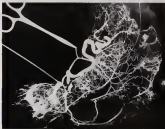


FIG. 13. GASTRODUODENAL ARTERY.

Next, the right gastric artery was filled. In this case, a narrow vessel arising from the gastroduodenal artery and supplemented from underlying pancreaticoduodenal (Fig. 14). A loop of small vessels from an accessory right gastric artery originating in the hepatic supplies the pylorus on the lesser curve. In the lateral view, the right gastropyloric, crossing the posterior aspect of the first part of the duodenum, was seen to supply branches to the anterior wall of the proximal 2.5 cm of duodenum. Fig. 15 demonstrates that the anterior and posterior walls of the proximal 2.5 cm of duodenum adjacent to the lesser curve may be dependent upon a primitive right



FIG. 14. Main gastroduodenal artery (arteria gastroduodenalis) supplying the stomach, pylorus, and duodenum. The left gastroepiploic artery (arteria gastrica inferior) and the right gastroepiploic artery (arteria gastrica superior) are also visible. The gastroduodenal artery is the main branch of the coeliac trunk.

gastro-epiploic artery supplemented by fine vessels from the underlying pancreas, the remainder of the first 2.5 cms being supplied by the right gastroepiploic.

It is interesting to note that Roth (1964), by incision of the duodenum at operation, caused an area of pallor to appear on the anterior duodenal wall as the size of 51 per cent of 100 patients with a normal pyloroduodenal canal. Mark further showed that the majority of ulcers and scars of 20 patients operated upon for duodenal stenosis lay on the anterior or posterior wall, midway between the greater and lesser curvatures (Fig. 15). These Watson and Roth (1964) comment that Mayo (1909) postulated that the frequency of ulcers on the anterior lateral wall of the first part of the duodenum was due to the impairment of acid rhythm in an area supplied by a small branch from the hepatic or gastroduodenal arteries, the lateral loop of which were not ulcers.

#### Current Gastroduodenal Operations

From a consideration of the many factors involved in the pyloroduodenal junction it appears reasonable to assume that normal gastroduodenal contractility, relaxation and propulsion are important in the design of operations to improve



Fig. 17 Pyloric region (note of *Endonchus* structure)

### LESSER CURVE

Fig. 18 Note of pyloric and gastric in 7th protractor, separated again for detailed view (black)



### GREATER CURVE

Fig. 19 At anterior (left side) 10th along pyloricopharynx dorsal (black) in view (1 mm scale bar)



parallel straight lines. Thus, there do exist conditions under these constraints.

The usual Hering-Müller effect (Hering 1909; psychophysics modified by Wundt 1912; 1958) involves closing an acute corner to increase opening up the lateral angles from  $27^\circ$  to  $300^\circ$  and closing new angles, as equally as the centre of the corner from  $160^\circ$  to  $0^\circ$  (Fig. 17). Angles can be closed only by having redundant transients allow the surface whilst opening angles widely will cause leading compression of field events and fields radiating from the point of corner (Wundt 1958; Fig. 17).

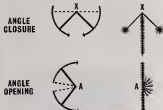


Fig. 17. (Left) Angle closure and (right) angle opening.

From 1909, examples based on my findings in the angular field and more the linear field along the new parts of the field, then appear as, now limited as an area of more redundancy which accounts for the same. Furthermore, more curved lines were given the only way to take up slack (Fig. 18). These lines appear as straight lines on radiographs (Fig. 18). Efficient advancement of the remainder of the interior with some parallel lines, some loops of corner inside lines, closely approximated passively and deepening, the field in the line of the corner with potential for increasing. Moreover, the advancement of the corner will cause some expansion in the corner line, radiating, playing the distance of linear line. The balance of 1.2 results in compensatory corner, and the corner deficit can finally be closed only by approximating the peripheral corner (Fig. 21). We then must to make a series of the models which confirmed the corner, expansion and increasing seen in radiographs (Fig. 22).

In attempts to improve upon the Hering-Müller operation, some suppose have resorted to the Hering (1909) psychophysics from which (Hering and Rand 1968)





Fig. 7a. Methods of suturing. (a) Differential suturing of maxilla with a wire. (b) Suture wire. (c) Closed maxilla with wire and suture. (d) Maxilla sutured 0.5 mm below 1.5° from angle of 1°.



Fig. 7b. Closure of maxilla, grade 1 and 2.

reported better drainage although Howard and Dyles (1994) rarely showed the influence of the obstructing space when they derived a modification to get rid of a Cus lined side wall. I think the problem will (Fig. 21).

In 1960, Holt and Lythgoe reviewed the techniques of Holt and Nagel (1957) and called it anterior palmarotomy. The operation attempts at raising an anterior flap of palatodental wall to exclude the spheno- and closing the defect. However,

as an upper stone, this can only be achieved by turning an incisor 90° (Fig. 11). We used this tool (Fig. 12) to assist those requiring mobilization of the second part of the stone during the Weber procedure.



Fig. 11. Mobilization of stone by turning an incisor 90°.



Fig. 12. Use of stone turning device to assist in mobilization of stone.

Close and Fox (1961) in their second publication discuss their technique for performing the procedure with turning the stone and stone as follows: (a) finally moving the stone into the stone; (b) finally moving the stone into the stone; (c) finally moving the stone into the stone; (d) finally moving the stone into the stone; (e) finally moving the stone into the stone; (f) finally moving the stone into the stone; (g) finally moving the stone into the stone; (h) finally moving the stone into the stone; (i) finally moving the stone into the stone; (j) finally moving the stone into the stone; (k) finally moving the stone into the stone; (l) finally moving the stone into the stone; (m) finally moving the stone into the stone; (n) finally moving the stone into the stone; (o) finally moving the stone into the stone; (p) finally moving the stone into the stone; (q) finally moving the stone into the stone; (r) finally moving the stone into the stone; (s) finally moving the stone into the stone; (t) finally moving the stone into the stone; (u) finally moving the stone into the stone; (v) finally moving the stone into the stone; (w) finally moving the stone into the stone; (x) finally moving the stone into the stone; (y) finally moving the stone into the stone; (z) finally moving the stone into the stone.

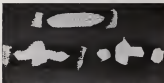


Fig. 13. Mobilization of stone by turning an incisor 90°.

#### Stomach-Inspected Gutter Drainage

Since modern operations for otitis media with effusion (OME) are performed, it is necessary to perform a procedure for drainage of the middle ear. The procedure for drainage of the middle ear is performed by the use of a drainage tube. The drainage tube is inserted into the middle ear and the middle ear is drained. The drainage tube is then removed and the middle ear is closed.



transmission of the blood flow, the lowest incidence of carcinoma is the stomach, the pylorus is a frequent site of cancer which may lead to pyloric stenosis, carcinoma with gastric adenocarcinoma spreading, an associated intestinal tumor, carcinoma. Attempts to design a jejunal (transmucosal) tube, resulted in the use of a transduodenal tube (Wool, 1970).



Fig. 26. Transmucosal plastic jejunal design.

## GASTRODUODENOPLASTY



ORIGINAL RECTANGULAR  
CIRCUMFERENCE - 10 cm

FINAL SHAPE AFTER  
CUTTING OF ANGLES



effect of angle on  
circumferential  
length

CIRCUMFERENCE AFTER CUTTING PLATE  
 $10 \times \frac{10 + 10 \cos 45^\circ}{2} = 10 \times 7.07$   
 NEW OR LENGTH - 7.07 cm (70.7%)

Fig. 27

Two lateral incisions, 1 cm in length, are made immediately posterior to the coronal vessels in the lower and greater portions of the first part of the dorsal end of the mobilized diencephalon. Since our experience studies have shown that anastomosis under the posterior wall relatively accurate in its location in the posterior, fitting only a size of 0.5 mm. Two anterior flaps are fashioned (Fig. 26) and, when opened, only a diencephalon 4 cm in circumference obtains an effective circumference of 11 mm. Angles should not be increased too grossly and probably 11 angles are adequate. The graph shows the progressive loss of the additional length by reducing the angle (Fig. 17). The diencephalon, after anastomosis, appears as the lower 50 and has the advantage of a wide, normal blood supply, normal contour, normal physiological responses and normal diencephalic. Cerebral, diencephalic, normal normal opening and closing of the posterior, anterior, posterior, and dorsal diencephalic normal diencephalic from normal diencephalic.



Fig. 26. Anteriorly directed and in the posteriorly directed, normal diencephalic.



Fig. 21. After a double end-to-end anastomosis of the coronary artery, the heart is seen in its normal position in the chest.



Fig. 22. Diagram of the heart, showing the site of the anastomosis.

When we first turned our attention to pyloroplasty, we were still thinking in terms of the Billroth operation where the union of dilated gastric antrum appeared to be the desired circular muscle of the pylorus which contracts, squeezes and massages its bulk forming a prominent peaked inflexion but on radiographs (Fig. 23). We devised therefore a technique of wedge pyloroplasty, to remove this inflexion. Through a small 2 cm incision an oval incision is made on the mucosa inferiorly and the mucosa separated to allow removal of the dilated muscular bag, the incision being closed transversely (Fig. 24). The operation has the disadvantage of a Billroth type closure leading to some distortion which can be avoided by employing a simple transverse anastomosis, approach. Figure 25 also clearly shows the site of removal of the bulge with a wide incision, but does not seem to develop a large distended bag possible because of interruption of muscular patterns (Fig. 24).



Fig. 23. Diagram of the heart, showing the site of the anastomosis.

The operation is feasible, however, in *P. pyloricus*. The anterior pyloric sphincter is traced through a 1 cm transverse elliptical incision immediately over the pylorus and apical third flaps are raised as separate units (Fig. 3). The oblique incision



Fig. 3. Anastomosis of *P. pyloricus*.

on the duodenal side commences inferiorly and passes obliquely upwards and dorsally thus preserving intact the main prearterial blood supply on the superior lesser curve margin. Flaps are transposed to widen the anastomosis. Abdominal incision differs only with various incisions in width of all dimensions of the stomach and thus 1/3 of ventral



Fig. 4. Abdominal incision in *P. pyloricus*. (Left) 1/3 wide.

the duodenal food not be exposed. Moreover, be careful not to cut the duodenum. There is no danger of post-operative infection, or gas in the circulation.

It will be seen from the above table that all angles well over a one half of 75° per unit incision, in width (Fig. 3). This however is achieved at the expense of increasing the anterior wall and narrowness for the slight forward angulation. The actual gain of *Loxia* depends upon the length of the incision. Narrower flaps with smaller angles have more mobility and fewer oblique circumferential kinking with consequent forward angulation, but are more difficult to suture, the blood supply is more precarious and the area increasingly oblique.

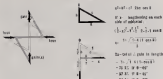


Fig. 10. Camera (a) of figure 8; (b) video of (a); (c) photo of (a).

# POST OPERATIVE CINE RADIOGRAPHY

The fractional results of these operations are best viewed by dynamic studies. However, cine radiography presents certain technical difficulties and results in increased radiation during exposure. I am therefore indebted to Joseph Constantino, Harvard, who has recorded our brain examinations on video tape using only the normal low TV minimum screening radiation.

A cine film of these video recordings using a new Harvard experimental technique was shown at the Symposium on Stereotaxis on 18 September 1969.

## ACKNOWLEDGEMENTS

Several colleagues have given generous assistance in these studies and I should like to thank particularly Jacques Lecomte, John Baran for assistance with the design of mechanical support systems. Computerists J. A. B. have also contributed generously by the patient and helpfully in the many aspects of radiography designed to assist stereotaxis and also with valuable advice on the radiography of bone mineral support systems. Dr. J. B. Brown has provided excellent and valuable laboratory support. The T. Centre of Medical Research has kindly provided technical assistance and John M. Squires and Mrs J. Roper-Smith have provided excellent help. Finally, my grateful thanks are due to Mr J. John Baran for his diagrams, Mr L. Williams for clinical and experimental radiography and Mr J. P. Thompson for technical assistance in the radiography and experimental procedures.

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## ATROPHIC GASTRITIS IN DYSPEPTIC PATIENTS

By J. R. Ehrlich

### SUMMARY

Gastric biopsy was performed on 107 dyspeptic patients over the age of 40 years. Varying degrees of atrophic gastritis were found in 43 per cent, the remainder having normal gastric mucosa. The incidence was lowest in those with duodenal ulcer, intestinal metaplasia not being found in any of the groups.

Hypochlorhydria was found in 77 per cent of those with atrophic gastritis and in 13 per cent of those with normal mucosa. The accuracy of barium meal, gastroscopy and gastric pH-metry in distinguishing between those with atrophic and those with normal gastric mucosa was low.

No significant haematological differences were found between the two groups of patients. Partial cell antibodies were detected in the sera of 18 per cent of those cases with atrophic gastritis.

Atrophic gastritis may be defined as an irreversible change of the gastric mucosa characterized by atrophy of the gastric mucousy cells together with a variable degree of reddening of the full thickness of the mucosa by chronic inflammatory cells. The severity of these changes is found in varying degrees and may be patchy or diffuse.

The importance of recognizing atrophic gastritis is threefold. Firstly, a proportion of patients with so-called benign gastric dyspepsia over their symptoms to the clinicians (Wynn Williams *et al* 1971) it should be said however that there is neither a clear cut symptomatology nor an accepted regimen of treatment for the condition. Secondly there is evidence that a causal relationship exists between chronic atrophic gastritis and Addisonian pernicious anaemia. Atrophic gastritis has been shown to have an intermediate form in a proportion of patients and it is in this group that the association is found (Davies and Matheson 1955; Maguen 1958). Thirdly, an association between atrophic gastritis and gastric cancer has long been recognized. In a recent Scandinavian survey Brattin, West and Widgerholm (1968) followed up a group of 118 patients with atrophic gastritis over a period of 15 years in the course of which nine developed gastric cancer. This compared with one in a healthy control group. The frequency of gastric cancer developing in the atrophic mucosa of patients with pernicious anaemia is well known. In a survey of an American population over the age of 50 years, Hunkeler and Schuman (1957) found that the frequency of gastric cancer in pernicious anaemic patients was 20.3 times the expected incidence for a healthy population. Further supporting evidence for the association between gastric atrophy and atrophic gastric mucosa is found in the frequency with which low levels of gastric acid output are found in gastric cancer patients. Some 50 per cent of these patients are achyloric or hypochlorhydric.

(Collerton and Enander 1967; Kolipetrah et al. 1969). Intestinal ectoparasites of the genus, *maecus*, is a frequent finding in atrophic gastritis, and there is considerable evidence to suggest that they may be the causal factor in the enhanced malignant potential of the condition. Magnus (1962) has shown that some 50 per cent of gastric cancers develop in mucosal ectoparasites, and that the incidence and extent of intestinal metaplasia is significantly higher in stomachs the seat of cancer. Such an association with benign lesions. Furthermore, histological studies have shown a close relationship between certain atrophic and metaplastic patterns in atrophic gastritis with intestinal metaplasia, and in carcinoma of the stomach (Wankberg 1959; Hatanaka and Watanabe 1960 and Lenn 1963).

The study reported in this communication was conducted with a view to investigating the incidence of atrophic gastritis in gastro-duodenal disorders and evaluating methods for its investigation. One hundred and seven hospital patients, were studied 70 being male and 37 female. The diagnostic groups from which they were taken are shown in Table I.

TABLE I  
Clinical diagnosis of patient studied

ESCHER NEGATIVE DYSPEPSIA	40
DUODENAL ULCER	21
GASTRIC ULCER	20
GASTRIC CANCER	10
PERNIOUS ANAEMIA	8
	100

*Gastric mucosa biopsy.* This was carried out using a hydraulic suction biopsy instrument (Quasthoff et al. 1962). This instrument is capable of taking multiple biopsies of gastric mucosa without the need of repositioning of the site between each specimen and is easily employed with the minimum of discomfort. No complications of any sort resulted from its use. It has the added advantage that each biopsy specimen is delivered into a vacuum receptacle so, as to allow the operator that being aware that adequate specimens have been removed before the take is withdrawn. 278 biopsies were taken from 106 patients by this method. Unsatisfactory biopsies were obtained from four patients who were excluded from the study. Five were obtained as specimens making up the total of 107. Of the 107 cases in whom multiple biopsies were taken, the histological appearances were similar between different biopsies in 90 per cent. In the 10 per cent in which different appearances were found the same same changes have been applied in the assessment of the present. A wide spectrum of histological appearances were found within the group studied, ranging from normal mucosa to gastric atrophy. The histological classifications of gastric mucosa, considerable difficulties and various classifications of differing complexity have been described (Schindler 1947; Magnus 1952; Palmer 1954; Jorde et al. 1955). These classifications depend upon the degree of mucosal atrophy and inflammation, and that employed in this study is a simplified one and is shown in Table II. In mild



and moderate atrophic gastritis there is a deposit of lymphocytes in the plasma and infiltration of the lamina propria or in the submucosa with plasma cells and lymphocytes together with eosinophils and often appearance of the fibers of the connective tissue. In severe atrophic gastritis there is atrophy and complete or nearly complete atrophy of the gastric cells accompanied by the inflammatory changes described above, while in gastric atrophy atrophy is complete and inflammatory infiltrations have well metaplasia is often found.

TABLE 8  
Stapled classification of Gastritis

NORMAL MUCOSA	MINIMAL
MILD ATROPHIC GASTRITIS	MODERATE ATROPHIC GASTRITIS
MODERATE ATROPHIC GASTRITIS	
SEVERE ATROPHIC GASTRITIS	SEVERE ATROPHIC GASTRITIS
GASTRIC ATROPHY	

The details of the histological findings in the groups of patients studied are shown in Table 10. The mucosa of 79.03 per cent of the 187 patients showed evidence of atrophic gastritis, this being severe in 29.17 per cent. Five of the 21 cases of duodenal ulcer had atrophic gastritis, this being severe in only two cases. Atrophic gastritis was found in 64 per cent of those with benign peptic dyspepsia, 73 per cent with gastric ulcer and in 78 per cent with gastric cancer. It will be seen that intestinal metaplasia was not found in any instance normal mucosa and that its incidence was 41 per cent in moderate and 63 per cent in severe atrophic gastritis. For this reason it was felt that it was as important to detect the lesser grades of the condition as it was to detect the severe ones and accordingly in reviewing the results of the later investigations, all cases with atrophic gastritis have been considered together irrespective of severity.

TABLE 10

The histological findings in gastric biopsy of 187 patients with dyspepsia. The figures in brackets represent per number in each category in whom intestinal metaplasia was found.

	No.	Normal Mucosa	Mild to Moderate Atrophic Gastritis	Severe Atrophic Gastritis	Atrophic Gastritis (all grades)	Total and Metaplasia %
No. With Dyspepsia	46	14 (30)	13 (28)	11 (24)	28 (60)	59%
Duodenal Ulcer	21	16 (80)	4 (20)	1 (5)	5 (24)	24%
Gastric Ulcer	19	3 (16)	11 (58)	5 (27)	19 (100)	100%
Gastric Cancer	14	3 (21)	11 (79)	1 (7)	15 (100)	100%
Peptic Dyspepsia	9	8 (90)	1 (11)	2 (22)	3 (33)	33%
TOTAL	109	44 (40)	41 (38)	19 (17)	74 (67)	67%

*Minimal Acid Output.* The secretory capacity of the stomach was estimated using pentagastrin as the stimulus of acid secretion, a dose of 6 mg per kilogram body weight being given intramuscularly. The output between 18 and 30 minutes after injection was taken as the peak output and adopted by three to give the maximal output of HCl per hour (Johansson and Jönson, 1946). The range of acid output in

those with histologically normal mucosa and in those with atrophic gastritis is shown in Fig. 1. The mean output for those with normal mucosa was 29.4 mEq per hour and 87 per cent of those patients had an acid output in excess of 10 mEq per hour. This is in contrast with those with atrophic gastritis in whom the mean output was 7.1 mEq per hour and of whom 77 per cent had an acid output of 10 mEq per hour or less. When those with atrophic metaplasia were selected, the percentage rose to 44



Fig. 1. The effect of normal acid output found in 17 patients with a histologically normal, and 10 with atrophic gastritis.

**Barium Meal.** This examination was carried out on each patient. The radiological features of gastric atrophy have been well documented by Lenn and Frimans (1965) and Beck, Kemp and Richards (1965). Employing their criteria of (a) mucosal folds of less than 0.5 cm, (b) a trabecula, (c) a small volume stomach, (d) a fold gastric fundus, and (e) the presence of 'house paper' folds in the body of the stomach, two or more of these features were found in 53 per cent of those with atrophic gastritis. Of those with histologically normal mucosa, the minimal abnormalities were deemed to be radiologically normal in 93 per cent.

**Gastroscopy.** Using either a Hopkins Taylor antirigid gastroscope or a flexible fiberoptic endoscope, atrophic gastritis was recognized in 53 per cent of 35 cases with histological evidence of this condition. Of the 19 cases with normal mucosa, the gastroscopic appearances correlated with the histological findings in 58 per cent.

**Gastric Photography.** This examination was performed on 45 patients using an Olympus B6 9 gastroscope. The examination was paired and photographs carried out as a blind procedure without radiological control such a view to assessing the confidence of this technique in the recognition of atrophic gastritis. Of 29 cases with histological evidence of atrophic gastritis, it was recognizable by photography in only 6 (21 per cent). Normal mucosa was correctly recognized in 15 (62 per cent) of 24 cases with normal histology.

**Microbiology of Gastric Mucosa.** These investigations are based on smears stained with MAYER'S stain (iron and aluminium of gastric mucus) (2). Corroding peroxid cell antibodies were sought by an immunofluorescent technique, using indirect indirect sections of human gastric body mucosa. The results of these investigations are summarized in Table IV. It will be seen that the means of all these values fell within the normal range when the cases were analysed by sex. A significant difference at the 5 per cent level existed between the mean haemoglobin concentrations of the males in the two groups, but no significant difference was found between the other values. Peroxid cell antibodies were found in 19 per cent of those with histologically atrophic gastritis, 9 per cent of males and 33 per cent of females. Gastric antibodies were not found in any case with normal gastric mucosa.

TABLE IV

Mean haematological values, and evidence of circulating peroxid cell antibodies in patients with histologically normal gastric mucosa, and patients with atrophic gastritis

	NORMAL MUCOSA		ATROPHIC GASTRITIS	
	Males	Females	Males	Females
Haemoglobin (g/100 ml)	15.6	14.3	14.0	12.4
MCV (fL) (10 <sup>12</sup> )	92.0	91.4	91.0	91.0
Haematocrit (%) (100 ml)	47.0	44.0	42.0	38.0
Mean corpuscular volume (fL) (100 ml)	90.0	94.0	90.0	90.0
Peroxid cell antibodies	0	0	0	33%

\*Excludes cases of atrophic gastritis, and patients with corpi found to exist.

\*\*Excludes patients with pernicious anaemia in whom a 50 per cent incidence of peroxid cell antibodies was found.

**Situation:** The overall incidence of atrophic gastritis in a group of dyspeptic patients over the age of 40 years was 45 per cent and of these, 51 per cent had increased metaplasia. This latter change was not found in any case with subsequent normal mucosa and was not found in any case of duodenal ulcer. It was found in all the other groups studied and was not correlated to degree with severe atrophic changes. Gastric cancer is rarely found in patients suffering from duodenal ulceration and while the numbers in this study are small, the absence of increased metaplasia in the duodenal ulcer group is in striking contrast with the incidence found in the other groups.

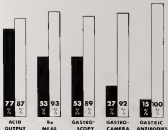


Fig. 2. Situation showing the percentage discrepancy between the findings of a series of atrophic gastritis patients and the pathologist's findings. For three positive and three negative atrophic gastritis patients and biologically also a control atrophic gastritis-free case profile. *Biopsy* with small intestine.

Of the various comparisons carried out, the comparison of increased acid output was the most reliable in demonstrating, between those cases with atrophic gastritis and those with normal mucosa as judged by biopsy findings. Frequent diagnosis of atrophic gastritis by any of the methods described above was uncommon (Fig. 2) and it is suggested that the diagnosis of this condition by any of these methods is likely to be correct and should be an indication for such further investigations as follow up in a controlled appropriate manner.

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## STRESS FRACTURES IN ROYAL MARINE RECRUITS

By J. Bottom

## ABSTRACT

The main features of stress fractures in Royal Marine recruits are that they occur in normal bones, most often those that are weight bearing. There is no history of injury, but there is usually a history of unaccustomed or major vigorous activity for some weeks before onset. The main symptom is pain on rest of the affected part and this pain is relieved by rest. Localized tenderness and soft tissue swelling are present at the fracture site when the affected bone is readily palpable. Radiological changes are absent on the first series in two days, but become visible within two months, unless treatment starts at stress onset early.

Stress fractures occur in normal bone in the absence of any definite trauma. They are incomplete fractures unless the preceding stress is continued, when they may become complete and may displace. They have always been more common in persons than athletes produce but in the last 25 years reports of their occurrence in children, notably children and athletes, have been more frequent.

## Material

Between January 1965 and April 1966 and over seventy-two stress fractures, excluding those of the foot, are known to have occurred in the Plymouth Command (Table 1). All but seven of these were in personnel undergoing man to command training at the Royal Marine Infantry Training Centre in Lyngstone.

A study has been made of the stress fractures suffered by these recruits who met all of above the same physical stress and who undergo the same physical stresses.

TABLE 1

	Lyngstone Recruits	Lyngstone Others	Plymouth	Total
Forearm (Dist)	1	0	0	1
Forearm (Dist)	0	1	0	1
Radius	0	0	1	1
Fibula	1	1	1	3
Tibia	10	4	3	17
Metatarsal	10	11	3	24
Total	11	12	4	27

STRESS FRACTURES SEEN FROM JANUARY 1965 TO APRIL 1966 EXCLUSIVE

During this period, 3,196 recruits completed their training and, of these, forty-two suffered long-term serious fractures (Table I).

The total number and incidence of acute fractures, chondromalacia patellae and soft tissue injuries in the recruits have also been noted for comparison (Tables II and III).

TABLE I

	1966	1967	1968	Total
Long Fractures	10	19	13	42
Transient Fractures	14	23	13	50
Spines, Ankles, etc.	162	160	91	413
Chondromalacia Patellae	15	52	30	97

TOTAL NUMBER OF SERIOUS FRACTURES, SPURIOUS STRAINS AND CHONDROMALACIA PATELLAE IN 1966 ROYAL MARINE RECRUITS

TABLE II

	1966	1967	1968	Total
Long Fractures	1.2	2.75	1.3	5.25
Acute Fractures	0.7	1.4	1.3	3.4
Spurial, Strain, etc.	29.8	29.4	14.6	73.8
Chondromalacia Patellae	1.6	3.65	1.7	6.95

INCIDENCE OF SERIOUS FRACTURES, ACUTE FRACTURES, SPURIOUS STRAINS AND CHONDROMALACIA PATELLAE IN 1966 ROYAL MARINE RECRUITS

#### Physical activity during training

The recruits spend in less than months at Exet, when they first join the Royal Marines, where their training includes drill, Swedish physical training and short runs and marches. They have to pass certain physical tests before arriving at Lyngstone where they spend at least sixteen weeks before completing their training.

During the first ten weeks at Lyngstone the recruits spend half of their time engaged in physical activities, namely drill, physical training, handcraft training on Gunter's route marching on roads, map marching across country and arctic course training. These ten weeks cover marches from 4 to 32 kilometres in length (3 to 20 miles). The recruits spend here in much a set standard as a course of tests before they can start the final six weeks of training which includes the reconnaissance course.

During the five weeks of the reconnaissance course more than half the time is spent on physical activity which is often prolonged and arduous. The aim of this course is to condition the recruits to marching under considerable physical and mental stress. There are three short field exercises, resulting on days and on nights which include cross country marches of up to 28.5 kilometres (18 miles). The endurance course is

sounded the trees. The course of a 5.6 kilometre (3.5 miles) march, a 2.4 kilometre (1.5 miles) cross-country course over logs, through ponds, through dry and water-filled forests and up and down steep slopes and a further 5.6 kilometre (3.5 miles) march, the whole course having to be covered in 90 minutes. There are four speed marches along country lanes from 6.4 to 16.3 kilometres (4 to 9 miles) in length and these have to be covered at an average speed of 5.6 kilometres (3.5 miles) an hour. The final test is a cross-country march of 40 kilometres (25 miles); the first half course open woodland, the second half along fully marshland lanes and the whole march is completed at an average speed of 4.4 kilometres (4 miles) an hour.

#### *Incidence*

The incidence of stress fractures is given in Table IV, from which it can be seen that 3 per cent of swamps suffered a stress fracture during the period under review. It was found that the incidence of stress fractures increased annually (Table II), Fig. 1) whereas that for the other injuries showed no consistent movement (Table II). Fig. 2). The overall incidence of stress fractures, stress fractures and chondromatous parasites was the same (Table III).

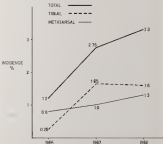


Fig. 1. Graph to show the annual incidence of stress fractures in 104 Japanese Swamps.



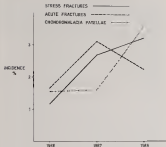


Fig. 2. Graph illustrating present changes in the incidence of stress fractures, acute fractures and osteochondritis patellae in 5,400 U.S. Army Airborne Soldiers.

#### Age

The average age of the women suffering stress fractures was the same as that for all the women in risk (Table IV) and the age range of affected patients was similar to troops-the peak was over twenty years of age.

#### Seasonal Variation

A diagram (Fig. 3) shows the monthly totals of stress fractures and it is seen that the lowest is in months in which there is no rain, and the highest is midway between heavy periods.

#### Symptoms and Signs

There was little variation in the presentation of the patients seen. The main symptom was pain in the affected part on exertion and this pain was relieved by rest. Some of the patients presented with pain of apparently acute onset, but in them it was usually possible to elicit a previous history of mild pain on exertion.

The clinical signs of local tenderness and local soft tissue swelling were found when the affected bone was readily palpable.

TABLE III

	1961	1967	1968	Total
Total at Risk	395	727	963	2085
Average Age	19 years	194 years	19 years	19 years
Total Bone Fractures	48	30	17	95
Proximal Humerus	1 (2%)	3 (50%)	3 (37%)	3 (3%)
Total Humerus with Bone Fracture	1	34	14	49
Average Age	19 years	194 years	19 years	19 years
Incidence of Bone Fracture at Humerus	1%	3.8%	3.0%	3.4%

AVERAGE AGE AND INCIDENCE OF BONE FRACTURES IN 2,085 ROYAL MARINE RECRUITS

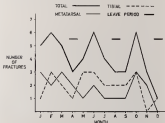


Fig. 1. Monthly total of bone fractures in 2,085 Royal Marine recruits.

### *Pathology*

The radiological appearance was similar to those already reported (Hartley 1942; Wells 1952; Green 1961 and 1963) but two points should be emphasized. Firstly, although changes may be seen as early as ten days after the onset of symptoms, they are often delayed for three weeks and on rare occasions for up to two months. Secondly, if diagnosis and treatment are prompt, radiological signs may be transient and easily missed. One patient was seen who had the symptoms and signs typical of a severe fracture of the tibia. He was treated accordingly by plaster cast immobilization and an abundant radiological signs developed. He was not included within study.

### *Pathology*

No abnormality has been found in the following investigations carried out on the last fifteen cases seen:

- (a) full blood count and ESR
- (b) serum calcium and inorganic phosphorus
- (c) serum alkaline phosphatase
- (d) serum proteins, total and electrophoretic pattern

### *Metatarsal Fractures*

Of the twenty-one metatarsal fractures eleven (52 per cent) involved the second rays (45 per cent) involved the third and three (14 per cent) involved the fourth metatarsal. The right foot was affected in nine patients (43 per cent) and the left foot in twelve (57 per cent). No recent volar fractures in both feet although one patient developed recurrent fractures of the third then the fourth and then the second metatarsal of one foot. Another patient with a fracture of the third metatarsal also had barked calcaneoiditis (Fryberg's disease) of the head of the second metatarsal in the same foot and a third patient sustained a tibial stress fracture four months after a metatarsal stress fracture of the same leg.

The metatarsal fractures were evenly distributed throughout the various weeks of trapping at Lyngby.

### *Tibial Fractures in tarsals*

Twenty three stress fractures of the tibia were seen and only five involved the middle tibia. Owing to the small number of cases the disparity is not significant and no reason has been found to explain it. Four patients had fractures of both tibiae, and in three of these the fractures were simultaneous. Twelve fractures were in the upper third of the tibia, five were in the middle and six were in the lower third (Fig 2).

### *Fractures at other tarsal joints*

The first tarsal fracture seen was typical, two being in the upper and two in the lower end. The seventh with the femoral neck fracture reported took 120 weeks after the onset of his symptoms because of a sudden exacerbation of his pain during a 24 kilometre (29 mile) march. The fracture was of the compression type described by Green (1961, 1963).

## CONCLUSION

The incidence of stress fractures is high in marine recruits. This must be related to the intense physical activity which the recruits face during training. Furthermore, for administrative and economic reasons the training period is kept as short as possible. In the report by Leitch (1959) on American marine recruits the incidence appears to be 0.01 per cent. Chaffin and Johnson (1961), when reviewing 1,000 cases of stress fractures in a marine corps had a naval recruit centre in America, found stress fractures to manifest for every two in a naval recruit. Furthermore, in that centre again, a variety of lesions was collected whereas in the naval recruit nearly all the fractures involved metatarsals.

The incidence of stress fractures at Lympstone is rising each year. To some extent this may be due to increased awareness of the condition leading to earlier and more frequent diagnosis (Hollinger 1961, Winfield and Dennis 1964). Another possible reason is that, although the overall training programme remained the same throughout the period of this study, the intensity of the training may have varied. This does not seem to be confirmed by a study of the other injuries sustained in training because

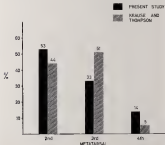


Fig. 4. Incidence of fractures in the metatarsal compared in this study by Krause and Thompson (1949).

the incidence of these injuries does not show any consistent change (Table III, Part II).

The pattern of stress fractures varies widely in different reports. Sharley (1943) and San Cugat (1945) reporting their experience with civilian patients, found that 54 per cent and 46 per cent respectively of their patients had metatarsal fractures. Moore (1944) however found that only 51 per cent of 500 stress fractures in American infantry recruits were metatarsal fractures, which is very like the findings of this study. The distribution of the fractures between the different metatarsals in this study resembles that found by Krusen and Thompson (1944) who analysed 300 metatarsal fractures in American army recruits (Fig. 4).

The proportion of tibial fractures in this study is high compared to the findings in

### SITES OF TIBIAL FRACTURES

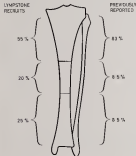


Fig. 5. Diagram to illustrate the sites of stress fractures in the tibia in Lympstone and other recruits.

cricketers (Hartley 1945) and American military recruits (Morris 1955). The high prevalence of these fractures in the upper third of the tibia was reported, because 10 per cent of fifty-eight fractures in military recruits, reported by various authors (Glenn and Thompson 1941, Frazier, Campbell and DeMott 1944, Miles 1945, Wolfe and Robertson 1945, Wong, Lowrey and Sevenson 1955, Swanson 1956) were in this part of the tibia (Fig. 3). Also, in reports of tibial fractures in children and young adults (Johansen and Topp 1938, Warner and Freeman 1940, Hartley 1941, Davis 1955 and Berkeley 1964) most occur in the upper one third of the tibia and the remainder are equally divided between the other two thirds. Davis (1955), however, has found that, in his experience, only about 10 per cent occur in the upper third except in children, in whom less than 100 per cent are in that site. In older children tibial fractures are usually in the lower third (Jonger and Mundy 1954, Davis 1954).

Further analysis of the tibial fractures in the recruits showed that eighty-six (79 per cent) occurred in the last six weeks of training, and furthermore, all six fractures of the lower third of the tibia occurred in this same period.

Davis (1955) reported that, in addition, tibial stress fractures were commonest in the lower third of the tibia. Therefore, it is probable that both the high prevalence of tibial fractures and their distribution in the tibia found in this study, are directly related to the nature of the last six weeks of the training.

The statement in distribution of stress fractures is different, whether it is probably related in some way to the preceding stress, as discussed by Swanson (1956), in a review of tibia stress fractures he noted that fractures of the upper third of the tibia were associated with jumping, and fractures in the lower third were related to running, marching and other sports. Davis and Swanson (1956) found that, in athletes, similar fractures were always in the lower half of the tibia. Davis (1955) also found that stress fractures of the tibia in athletes were in the lower third. However, in ballet dancers, five patients reported by Swanson (1956) and one by Davis (1955) tibial fractures were anterior and medial in position. Swanson (1956) thought that these fractures were associated with the leaps performed by the dancers, especially in feet of his patients were male.

In American service recruits a high proportion of unilateral stress fractures was reported by Hollinger (1946), Leitchman (1955), Gillett and Johnson (1964) and Morris (1965). Leitchman (1955) found that the incidence of these fractures was not reduced by efforts to lessen direct trauma to the heels of recruits during drilling and marching. Subsequently, it was found that these fractures were eliminated by using a very narrow form of full lower breeding exercise (Davis 1955). Such exercises were not performed by the recruits at Lympstone, which explains the absence of these fractures in this study.

#### Conclusion

Many aetiological factors have been cited in the past, but since most stress fractures occur in weight-bearing bones, it is reasonable to think that direct mechanical stress might cause the fractures. However, there is some evidence to suggest that some other factor must be considered. Firstly, the tibia is a slowly growing, a weight-bearing bone and fractures in the upper third and medial aspect are due to direct mechanisms.

stress. Secondly, the fact that ulnar stress fractures are only eliminated by removing indirect stress and not by reducing direct stress. Thirdly, the pattern of stress fractures should not vary with different exercises since the mass of weight-bearing will be similar whatever the activity.

Davis and Freeman (1950) showed that contractions of the calf muscles strain the fibula to bow towards the ulna. They postulated that fibular fractures occurred at the site of greatest stress, determined by the bowing, distal the inferior ilio-tibial joint.

Thereafter, on landing a foot, stress will be greatest at any point where there is a change in the direction of movement, that is, at the apex of a bend and at each end of the mobile segment as it junctions with a relatively unmovable part of the bone. This is well illustrated by the fibula (Fig. 4).

Both the tibia and the fibula are curved bones. Some muscle groups acting across the curvature of these bones, are working at a considerable mechanical advantage

#### EFFECT OF CALF MUSCLE CONTRACTIONS ON THE FIBULA

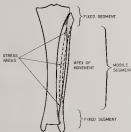


Fig. 4. Diagram to illustrate the action of calf muscle contractions on the fibula and the sites of stress.

and act as a bowstring mechanism, for example, the collection of the thigh, the knee-drops and the calf muscles (Fig. 7). Contraction of these muscle groups tends to increase the bowing of the femur or the tibia, leading to compression of the anterior and distraction of the posterior surfaces. Weight bearing also causes an increase in the bowing of the femur and tibia and so will reinforce the stress caused by muscle contraction.

The site and nature of stress fractures in the lower limb accord well with the above statements. Stress, compression fractures (Davis, 1961, 1963) occur on the anterior surface of the tibia and in the supracondylar region of the femur, on the posterior

### BOWSTRING ACTION OF CALF MUSCLES

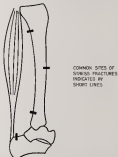


FIG. 7. Diagram to illustrate the bowstring action of the calf muscles and the common sites of stress fractures.



aspect of the tibia just below the condyles and on the lower third, and on the distal surface of the calcaneus. Unstable, transverse fractures occur on the upper surface of the neck and on the posterolateral aspect of the midshaft of the bone, and on the anterior aspect of the midshaft of the tibia.

The variation of the patterns of stress fractures with different activities has to be explained. Each activity will cause variation in the contribution that the different muscle groups make towards the stress imposed on the limb bones and it is suggested that these variations might well explain the different patterns of stress fractures that are found.

In view of the evidence and the proposals made, the author considers that indirect muscle action is more important in the aetiology of stress fractures than the direct mechanical stress weight bearing.

#### *Importance of stress fractures to women*

Early diagnosis and treatment avoids —

- (1) A partial fracture becoming complete and disabling (Basmajian 1958; Dumas 1967). This may lead to permanent crippling, especially in cases with a femoral neck fracture (Jones 1964).
- (2) Over-treatment of the patient: a separation has been reported for suspected malignancy (Gibbs, 1973). A fracture was suspected in one case of right stress fracture in this study.
- (3) Unnecessary withholding from the Service.

Invaliding may result from the disability following displacement of a fracture, but it may also follow delayed diagnosis leading to delayed healing. The healing of fractures involves considerable physical effort and discomfort, and this is necessary to build up the very high muscle and physical fitness required in Royal Marines. Any interruption of this training, especially from illness, may result in such a loss of morale that the recruit never regains the necessary mental and physical fitness to complete his training. With early diagnosis, not only will recovery be hastened, but also a definite prognosis can be given and a plan of rehabilitation can be drawn up to maintain the interest and morale of the recruit while he is in hospital and even while his training.

#### PREVENTION

Care is taken to build up physical fitness in marine recruits before they start their training at Lympstone. Nevertheless, there is still a high incidence of stress fractures, especially in the last six weeks of training. It is proposed that many of the knee fractures are caused by the speed and long distance marches. It is suggested that these marches should be introduced to the training programme in an earlier stage and that there should be a more gradual build up to the final pre-war standards in these marches.

#### SUMMARY

Stress fractures in Royal Marine recruits have been studied.

Three main features are that:—

- (1) They occur in normal bones, most often those that are weight bearing

- (2) There is no history of injury, but there is usually a history of unaccounted or minor trauma (usually for some weeks before onset).
- (3) The most symptom is pain on use of the affected part and the part is relieved by rest.
- (4) Localized tenderness and soft tissue swelling are present at the fracture site when the affected bone is readily palpable.
- (5) Radiological changes are absent in the first seven to ten days, but become visible within two months, unless treatment starts or stress ceases early.

In the present study the cases provided the characteristic sign of stress fractures in certain women just entering the menarche. This phenomenon is probably explained by the type of training which the women undergo. More preparation for the speed and long distance marches is suggested to reduce the incidence of stress fractures of the tibia.

It has been found that the incidence of stress fractures is very similar to that of acute fractures and chondromatous nodules.

It is proposed that isolated muscle action is the most important factor in production of stress fractures in young adults.

#### ACKNOWLEDGMENTS

Most of the figures on which this paper was based were laboriously assembled by Margaret Cunningham (B. Sc. B. Med.), to whom I am very grateful. I would say that I think the girls' Captain P. D. G. (Pugh) has more merit in management and achievement for the help and advice of the St. Andrew's Nurses and Mr. M. S. Davis.

#### Literature referred to

Following a Working Party set up during August, 1959, to investigate the recent striking epidemic, as one of a group in County Antrim, certain osteomatoses were accepted and not the complementary in the tibiae. In the main these are:

- a. Isolated osteoplastic fractures earlier in the leg, but based on stress training and usual running.
- b. Major adjustment in the preparation of the upper tibia in STAM.
- c. Minor, the two tibiae tend and maintain an equal pace with a type in following the situation after 40-50 mps have completed the modified regimen.

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## SURGERY FOR LUMBAR DISC PROTRUSIONS

By Philip C. Pollard

### ABSTRACT

A series of 39 conservative cases of applicants for proposed lumbar intervertebral disc resection is presented. Clinical diagnosis suitable use of myelographs is discussed and operative techniques outlined. Results are assessed in their Service background. These are comparable with other series, most three-quarters being classified as good. Reasons for failure are discussed.

This paper is of a series of 39 conservative male cases of lumbar prolapsed intervertebral disc operated on at RM Hospital Haslem between September 1967 and March 1969. These cases formed the first wave from over 400 referrals for back pain or sciatica. The operations were performed equally by Surgeon Captain B. V. Jones and myself.

Follow up presents some difficulty in Service conditions as successful cases may be drafted to any part of the world and others are lost to study when they leave the Service or the end of their engagement or emigrating. This is a 'paper' review as it has not been possible to see all the patients personally. Even this type of review has its limitations but the situation should be greatly improved when the proposed Joint Service Computer Assisted Records System is established and the current re-designing of the present F. Med. system is able ordered, hospital folders for each patient is completed.

### SITE OF THE LESION

The level and site of the lesions operated on is shown in Fig. 1. The distribution conforms with that reported in larger series with about half of the procedures at L5-S1 level and only a few at L2/3-4. Left sided predominance is shown and although this is hardly significant in this small series it has been reported elsewhere and remains unexplained (O'Connell 1951). Five double procedures, all L4-L5 and L5-S1 were found. Two negative explorations are noted. In one there was no neural protrusion, but swelling from old haematomas was found 'with some relief'. The other was completely normal and after operation had one of the best results in the series.

### AGE OF THE PATIENT

The age range of 18 to 44 with a mean of 30.1 would seem to show a clear curve suggesting that the condition is far commonest in the twenties and the age distribution on the Royal Navy is superimposed when a good match is made. Onset of symptoms on the attack which led to surgery was recorded as gradual in 30 and sudden in only four cases. Trauma was remembered and recorded in the cases in only 19. Sports injuries were common and also, surprisingly, blows on the back reported by

Level	Left	Right
1.5.4	2	0
1.4.5	10	11
1.3.6	17	13
Double	3	2
Normal	1	1

Age Range 39-64 (Mean 50)

Onset	Radical	9
	Graded	30
History of Trauma		19

(Fig. 1)

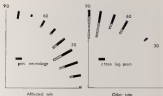
five cases. Especially nasal cases were a fall down a hole, starting a slip and being a drunk. Two bilateral frontal parietal developed symptoms respectively after falling a pole, and after falling against a bar between off-bow. Half the cases were operated on during that first attack, the remainder after between one and five previous recurrences.

#### DIAGNOSIS

Diagnosis was essentially clinical. All cases showed some limitation of lateral flexion and a postural deformity was recorded in 74 per cent. Depression of straight leg raising has been emphasized as an important diagnostic sign (Hartley 1951) and Fig. 2 shows the angles recorded before operation. The majority show marked limitation and the few which were nearly full were all long-standing cases with previous attacks after prolonged wet work and periods of light duty.

The picture of *distans neurological signs* is indicated by the black areas and are expressions of that when these are present they are a helpful but not infallible guide to the level of the lesion. Weakness of the extensor hallucis longus indicates a L4/L5 lesion and dominance of strength of the middle pike a L5/S1 protrusion. Reduced opposition of great toe is common in the appropriate distribution but commonly found. The accurate distribution of these signs may require careful and repeated examination.

Myelography using an oily medium was carried out in 38 cases (Fig. 3). Opinions vary on the value of this investigation, with a majority of workers considering it unnecessary in the straight-forward case (Armstrong, 1961; Luschke and Ford, 1960; Ford and Ray 1955). In this series there were five confirmed failures due to extra-



SPREADSHEET 1980 1981 1982

Fig. 2

# SYNTHESIS

Rep	Opn	No
1	1	22
2	2	2
3	3	3
4	4	4
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96	96	96
97	97	97
98	98	98
99	99	99
100	100	100

Fig. 3

based on the results of the analysis, and the myelography and spineography findings agreed completely in only 50 per cent. If the negative results are acceptable as the markedly altered position may not reflect the disc, but surrounding tissue processes may lead to the

unconscious impaction of the spine. Patient feelings may vary from slight apprehension of root closure to *phobia* even to gross postoperative blocking the dental canal. Myelography is seen as a very useful and useful anastomosis when there is clinical doubt or difficulty, but in the completely typical case it adds little to the management, other than to reassure or worry the surgeon as he approaches the disc space.

### SURGICAL MANAGEMENT

Indications for surgery were not usually laid down, and may be summarized as failure of conservative treatment to produce an acceptable result. This ranges from the case with continuous acute pain which cannot be relieved to the patient who has been fully disabled for some months after his acute postoperative had a stable to accept chronic pain and disability.

Operation in all cases was performed in the lateral position, using as the first approach an interspace or laminectomy technique with minimal tissue removal. The majority of operations were completed with this lateral approach, but wider exposures with extension of part or the whole of a laminar were used whenever more access was required. One protrusion was successfully treated through a percutaneous posterior fenestral access.

After operation the patients were nursed free to bed, and allowed to move, sit up and get up as comfort dictated. This usually resulted in the patient being fully ambulant by the seventh or eighth day, when he commenced a course of progressive spinal retraining exercises.

### RESULTS OF TREATMENT

Results have been assessed in functional terms (Fig 4). An excellent result is one in which the patient has no significant residual complaints with a full range of spinal

#### RESULTS OF SERIES OF 59 CASES

Excellent	26
Good	11
Fair	4
Poor	3
Excluded	4
Complications	1

Fig 4

and leg movements. All these patients have returned to full day going duties, two as nuclear subcontractors and one nurse operator, excluded in a Physical Training Institute. Good results are those in which the patient is satisfied and is in an unimpaired category but has some residual complaints or physical signs. Patients with

mild back pain or slight weakness or sensory changes or with previous herniated or spinal lesions and straight leg tests, but no pain, was included in this group. These two groups together represent the vastness of the series and form 75 per cent of the total.

Poor results are those in which the patient's symptoms have been definitely improved by operation, but still represent some disability. At the same time, of these we still under treatment and review or employed in relatively sedentary duties. Poor results are those that have gone on and on, or have become worse by operation and have constituted disability.

Our series from the series have been included in this, though because of the short follow-up this number will probably increase to eight or nine in the final count.

#### DISCUSSION

These results must be seen in their British background. A result which may be adequate for a civilian back clerk will certainly not be good enough for a Royal Marine Commando, and certainly may be necessary even with a relatively good result. On the other hand, a highly trained and skilled senior technician may be of value to the Service and will be retained with a far easier job. Nordfield in 1946 reported similar results in 45 army patients.

The general level of these results is on a par with those published for other series (Parker, 1947) and suggests that the techniques and methods are similar to standard practice. No reports of large series of severe disc lesions beyond conserving rely are available for comparison. Most of severe cases now employ surgery for the acute case, but a series of 20 proven disc lesions, followed without operation for one to eight years by Colson and Frobenberg in 1949, showed only 25 per cent freedom from pain, 45 per cent being forced to change their occupation.

It seems fairly clear that a higher percentage of better quality results can be obtained surgically. These cases return to completely normal activities and are lost to follow-up. A chronic syndrome of failures accumulates in outpatient departments and are not possible for the continued slightly doubtful reputation of disc surgery. It is difficult to be strong about patients who deal with an operative failure, and yet the majority of patients suffering from acute lesions, resolved by weeks or months of conservative treatment, will willingly and in our opinion, rightly accept a 75 per cent chance of a satisfactory result from operation. In Service conditions the end results of the series may perhaps be expressed more accurately in terms of cases lost from duty during the months at good times, a proportion of whom would undoubtedly have come to requiring an last operation (Fig. 5). This shows a mean time in hospital after operation of 14.4 days, with return to light duties in 1.6 weeks and appearing to full normal duties in 2.1 months. In these days of shortage of manpower and long exposures training for a skilled technical Royal Navy, this is surely worth while.

At this stage the controversy about the place and indications for disc surgery becomes almost philosophical. Can we look at the whole series and quote Harkness (1945, 'disc series' a bit, which presents the greatest happiness for the greatest number—or should we look at the less successful cases and wonder whether they would be or settled spontaneously with a few more months of conservative care?



## ACTIVE OBSERVATION

Time, in Hospital	OP	10-15 days	Mean 14.2 days
Early Discharge	77%	4-5 weeks	Mean 5.6 weeks
Late Discharge	23%	1-3 months	Mean 5.7 months

Fig. 2

The focus of the surgery must be in reducing the present level of non-discharge cases. Aspinewey (1961) estimates that wrong diagnosis is the most frequent cause of failure. This applies to only one case in this series, who has an excellent result from a completely normal exploration. He also lists 12 other causes in the patients with genuine lesions. No general pattern could be detected in this small series, but it is certain that attention to ductal and pancreatoduodenal techniques both in diagnosis and during surgery are essential requirements. Results in Norway need care should be better than in certain practices because of the fit young population served and the lack of economic pressure at least for the first five months of illness. The numerous conditions of day-to-day life ensure that our results are well tested.

It is considered that this review justifies the continuation of this surgery in the Service, but shows the need for continued effort to reduce the percentage of unsatisfactory results.

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## INSTABILITY OF THE KNEE JOINT AND ITS CORRECTION

By B. Viktor Jensen

### ABSTRACT

The management of ruptures of the medial and cruciate ligaments of the knee is discussed. The importance of capsular damage and consequent rotational instability in combined ruptures of the medial and anterior cruciate ligament is emphasized. Flattened capsular capsule of repaired cruciate ligaments is often impossible, and joint arthrodesis procedures to provide a replacement for the ligament are complicated and have proved disappointing.

The importance of capsular laxity is emphasized and two new operations to correct this are described. One is a simple medial capsular advancement in current minor rotational instability; the other is a reinforcement of the capsule with strips taken from each side of the ligamentum patellae. These operations are simple and initial results have been promising.

Instability of the knee joint following injury to the collateral and cruciate ligaments is a common cause of disability in the forearm and frequently results in avoiding. The purpose of this paper is to define present thoughts on the problem and to describe some operations to restore stability to these joints.

### *Medial ligament*

Isolated rupture of the medial ligament is not controversial and will not be considered in detail. It is caused by a forced valgus stress. In most cases, with tearing of a few fibres of capsule and ligament only, the joint remains stable and protected by opening in a plaster cylinder for a few weeks is all that is required. More severe injuries rupture completely both the deep and the superficial capsular parts of the ligament, often in one or other of their bony attachments. Instability of the joint results and can be demonstrated by abducting the leg with the knee extended; the tibia comes to open up on the medial side. In these cases operative repair by direct repair is necessary. In late cases this can still be done by overlapping the scar tissue which will have formed between the ends of the ligament and more complicated procedures such as substituting a new ligament by anastomosis one of the human or animal are seldom necessary.

### *Anterior cruciate ligament*

Ruptures of the posterior cruciate ligament are being recognized more frequently. The most common cause is the knee against the pedal iron (sissy) of the car passenger in which the head of the tibia is driven backwards. A history of this type of injury should raise suspicion that the posterior cruciate ligament may be torn and, if there is a haemarthrosis, it should be aspirated under general anaesthesia and the knee

is checked carefully. If some backward movement of the tibia on the femur is compared with the normal knee weakness then the ligament has been torn.

Trasky (1964) made a notable contribution to describing a simple posterior approach through which the ligament can be repaired. Sometimes, however, an avulsion of the anterior attachment of the ligament is found at operation when the joint has been approached from the front, perhaps so that such a corresponding wound as to take out a specimen. In these circumstances it is possible to put a strip of 1/8 chrome suture through the free end of the ligament, leaving the end long, passing each of them out through the popliteal fossa on a long straight needle and tying them together over a rolled up gauze swab. This will at least hold the ligament down into something like its proper position, and with splintage it may heal so that normal continuity is restored.

#### *Anterior cruciate ligament*

Rupture of the anterior cruciate ligament is the classical cause of instability of the knee and is the main subject of this paper. It is caused either by hyperextension, as when a heavy weight falls across the extended knee, or by a rotational injury, as this more often great situations are likely to be torn. The patient usually presents after injury with a haemarthrosis and when this has been aspirated, the well-known drawer sign is positive (Figs 1 and 2).

When the knee joint is explored, a simple evulsion of the lower attachment of the ligament may be found, and it may then be possible to repair the ligament with two or three 1/8 chromic suture stitches using a very small curved needle such as a Lane's cloth pinch needle. If the knee is then operated in a slight flexion for 4-6 weeks the ligament may be expected to heal and give a satisfactory result. It is more usual, however, to find that the ligament has ruptured in the way that a repair patch would make sense, leaving a mass of frayed ends which cannot possibly be repaired. The classical picture here becomes more complex because although the ligament cannot

Fig 1 The drawer sign demonstrates a torn anterior cruciate ligament



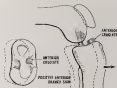


Fig. 1. The anterior also demonstrates a new anterior cruciate ligament.

be repaired the joint may still end up with a stable knee. Most surgeons have had the experience of opening a knee which appeared to be completely stable to carry out some procedure such as arthroscopy, to find a complete rupture of the anterior cruciate ligament, yet the knee returns to apparent normality after the operation, despite the fact that the ligament has not been repaired.

It seems, then, that isolated rupture of the anterior cruciate ligament does not necessarily give rise to any symptoms. It is the combination of anterior cruciate rupture with laxity of the joint capsule and medial ligament which is so disabling. This fact has long been recognized and O'Donoghue (1955) has described as 'the unhappy triad' the combination of rupture of the anterior cruciate ligament with rupture of the medial ligament and a torn medial meniscus, though the sort of injury which ruptures these ligaments is torn with the partially flexed knee while bearing its full weight. It is perhaps even more likely to tear the ligament when the knee is bent.

In many cases direct repair of the anterior cruciate ligament is not practicable and many operations have been devised to replace it with other structures. May Green used fascia lata for the purpose some fifty years ago. Later Nagamine used the non-articular tendons and finally the medial meniscus. Lane (1957) used a strip of the patellar ligament, leaving it attached at its tibial insertion, and this method was developed by Corran (1962), but the patellar tendon can withstand only few pounds either way in full knee movements or can strain in competitive sports. Lane (1955) described a complicated modification of this method which at a short term at least has given better results than one half of the standard required by basketball or football enthusiasts.

All these operations have attempted to reconstruct a new intra-articular ligament lying in the exact path of the old one and the results leave for the most part little

disappointing. It seems possible that these operations have failed, not only because of the technical difficulty of so shortening the new ligament that it is tautness in the right tension whatever the position of the knee, but also because they do not deal with the capsule itself which is such an important factor in the instability syndrome. The three operations to be described are all designed to correct the capsule itself.

#### Rotational instability

Understanding of this problem has been clarified by Shotton and Larsen's (1964) recent recognition of the concept of rotational instability. They have shown that undue laxity of the medial part of the capsule allows the medial tibial condyle to slide forward so that it swings the leg into internal rotation on the axis of the femoral ligament; the undue antero-posterior movement of the medial tibial plateau making the joint unstable.

To assess this it is first necessary to know what the normal range of rotation of the tibia on the femur is. This is a matter on which the majority of workers are completely agreed. However, in connection with certain parts of research this has been measured in twenty younger men. In full extension no rotation is possible with the knee flexed at a right angle, an average of  $31^\circ$  internal and  $5^\circ$  external rotation was possible. This accords well with Shotton and Larsen's statement that anything over  $30^\circ$  of external rotation should be regarded as abnormal.

Rotational instability is caused for by a modification of the drawer test. Before doing this test the leg is normally rotated  $35^\circ$  to replace the situation on the medial side of the joint and prevent the head of the tibia coming forward, even if there is a cruciate lesion. Under these conditions the medial tibial condyle will swing forward and rotational instability is present (Fig. 2).



Fig. 2. The drawer test carried out with the leg normally rotated  $35^\circ$  gives no drawer even though rotational instability does in fact exist in the medial capsule.

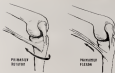


Fig. 6. *Alston and Lister's percutaneous technique to correct rotational instability*

To correct this, Alston and Lister (1960) devised the operation of percutaneous transplant, in which the ends of the joint ligaments are turned upwards and is inserted so that they act in antirotal rotation of the tibia rather than knee flexion (Fig. 6). This operation has been done on two occasions: both knees were improved.



Fig. 7



Fig. 2

but like the Australians who have tried this method, we are not entirely satisfied with the results. This operation suffers from the fundamental defect of all attempts to use functioning tendons to replace ligaments, which is that the muscle may fail or contract in the unguarded position when it function is most needed.

A simpler measure to deal with rotational instability which I have used as a number of operations is a simple key advancement of the medial capsule. Using a J shaped incision that can conveniently be used as the approach for a medial meniscectomy, the capsule being torn up with double lifting along two rows of suture stitches. This is an easy way of dealing with minor instability (Fig 3).

For dealing with the more difficult case of anterior and capsular instability, an extra-articular repair has been developed using a strip from either side of the ligamentum patellae to reinforce the capsule. The strips are left attached to their normal insertion distally, on the medial side the proximal end is looped through a buttonhole in the medial ligament and on the lateral side into a rough, oblique condensation of the capsule which is stronger than the anatomical lateral ligament. The capsule is secured back to the remaining part of the patellar ligament and the tightening of the capsule which the adherent is probably as loose as important as improving stability as the effect of the reinforcing ligaments (Fig 4).

This operation has given promising results in the few cases in which it has been

dear and a Royal Marine sergeant whose knee was so unstable that he was about to be invalided has been ordered to full duty in Category (F).

Experience of these three operations is as yet very limited and the long term results are not known. Much more work needs to be done on this important and intriguing problem before the place of these various operations can be firmly established.

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## SESSION II

## Abstract

LAWRENCE D. W. TEPHAN

A PILOT SCHEME FOR THE EARLY DETECTION OF  
POTENTIAL HYPERTENSION AND CARDIAC INFARCTION

## ABSTRACT

A project aimed at the early detection of cardiovascular disease involving the screening of 2,000 naval recruits between 15½ and 16 years of age. Preliminary electrocardiographic findings are reported and a system of coding of visual infarct photographs is described.

## PART I. INTRODUCTION

By LAWRENCE TEPHAN

In 1955 Dr William Evans, at that time Consultant Physician and Cardiologist in the London Hospital and Consultant Cardiologist to the Royal Navy, submitted to the Medical Director General a proposal that a research project might be undertaken amongst young male personnel on their recruitment into the Royal Navy.

At that time, for various reasons it was not possible to implement this proposal but in 1962 a re-examination was put forward in connection with a possible research project involving an extension to improved electrocardiography to the Royal Naval Medical Service.

It is suggested that coronary arterial disease manifests itself already through the onset of cardiac pain in patients both within and outside the Navy; it is not a disease of late adult life when the symptoms appear, but one which starts in early life. There is pathological and some electrocardiographic evidence that this is true, and there is need to prove it reversibly for if treatment of the condition is to be initiated it should be initiated in these younger subjects in whom continuation of the disease has been possible.

The principal aim of the project is the possible early detection of cardiovascular disease, in the form of hypertension or coronary artery disease itself. The subsidiary aims are the assessment and analysis of the normal variations in the adolescent male electrocardiogram and infarct photographs.

As a result of this proposition, a Pilot Survey involving examination of 2,000 recruits entering the Navy was therefore initiated in the early part of 1966 in HMS Ganges. It was arranged that approximately 500 recruits between 15½ and 16 years of age would be examined weekly during a forty week year over a five year

period, and that a random selection should be made on the last digit of the patient rating's ship's deck number, including 0 on as every 10. The inspection investigations included a full physical examination incorporating estimation of blood pressure, the condition of the bronchial tree and some examination. The presence or not of Polydala (sawney) supply is perhaps an indication of abnormality elsewhere was noted. Upper body photographs were full face and profile views in upright photography, chest X-rays in the P A and left oblique positions, frontal photographs of each eye with colour disks obtained from a Zeiss Fuchus camera, and multiple ECG tracings including both the V and CR leads was carried out.

These tests are to be repeated at intervals during the ratings term of service and the main purpose is to be observed subsequent to his discharge into a civilian occupation. By the time these individuals reach their fourth or fifth decade of life it is envisaged that maximal information will be available concerning the two pathological states of coronary arterial disease and hypertensive heart disease which may make a contribution to our knowledge of their aetiology.

As will be seen by the end of the year 1964 over 500 recruits had been investigated and Dr Evans has personally assessed the ECGs of all these individuals. The scheme has continued during the past few months but as there has been a change of medical personnel at Gosport the most recent results cannot be incorporated in the reports of my two colleagues. Naturally all the material collected with the interest in being referred to Gosport to which the selected personnel will return for re-examination and repeat covering them as soon as practicable that their first or subsequent applications for re-employment for further service in the Royal Navy, and again prior to their release from the Service. Duplicate medical documents have been compiled and in the Service Medical envelope in Gosport the ECG records, fundus photographs and X-ray tracings are placed.

In the event of Cardio-Vascular System Project groups being situated in hospital or sick quarters for any illness involving the CVR, details of the diagnosis and continued duration of sickness are reported on a form and forwarded to the co-ordinator of the project at the RM Hospital, Haslemere Road, Haslemere apart from the clinical findings it is hoped that some evidence may be forthcoming from the interpretation of the ECGs (which will continue to be read by Dr Evans at his retirement) concerning the potential candidates for coronary arterial disease in later life, and from the retinal photography as a similar measure on the case of hypertensive subjects.

## PART II ELECTROCARDIOGRAPHY

By A. G. Wilson

It has long been the conviction of Dr William Evans, that there are early signs in the electrocardiogram which may indicate a myocardial fault and which may help to predict it.

There are two attitudes to electrocardiography: the analytical and the clinical and it is the latter to which Dr Evans alludes. Few people need reminding how

often has theories from which proceed concepts by the nervous system; since. The particular object of this report of the Glasgow ECG Project is to test the validity of these beliefs.

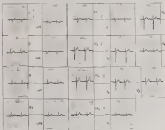
This short communication deals with the frequency of the signs described from 800 of the electrocardiograms Dr Evans has analysed, all taken from healthy middle adolescents, each approximately 14 years. The collection continues and the final total will be 2,000.

The selection is on a strictly random basis approved by Sir Austin Bradford Hill based on the last digit of their Stages Book number.

There are protagonists of each of the cuspal and bipolar leads. Dr Evans favours the latter, but to avoid possible favouritism a 12-lead ECG was taken I, II, III, IIR, aVL, aVF, aVR, CR1, CR2, CR3, CR4, CR5, VI, aVF. There have been mistakes in such a way as to facilitate comparison of the cuspal leads: a subject not under discussion in this communication.

The only signs described by Evans (1952, 1961, 1963 and 1965) are to take them in the order of the PQRST complex.

1. The appearance of Q in IIR when absent in II



Physiological

Fig. 1





## Plane

Fig. 4

100%. Figures 3 and 4 also show ST signs. These signs are the commonest on the series and average 21 per cent of the whole sample.

Figure 5 shows most T waves with an indeterminate T for comparison. Figure 6 is self-explanatory, complete absence of S in lead I.

The rarer signs are illustrated in Fig. 7. Leads CR1 (4 per cent), QTR1, 0.55 per cent.

Figure 8 shows a graphical summary. It should be noted that the total number of signs is not the sum of the individual variations, as many ECG's show two or more of the features described.

The high numbers of signs recorded in samples 500-600 and 700-800 emphasize

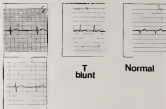


Fig. 1

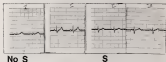


Fig. 2

for need for the confirmation of recordings to the planned 1,000.

The total incidence (about 58.4 per cent) certainly gives one food for thought.

#### SUMMARY

To summarize, the findings described above have been noted in the electrocardiographic screening of 800 14-year-old naval ratings, all of whom were healthy and had been subject to a stringent medical examination. The Navy has the reputation and the ability to follow up these ratings at approximately 70 per cent of them up to the age of 21, and at 50 per cent, beyond.

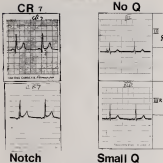


Fig. 7

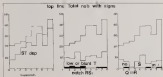


Fig. 8

It is vital that the results of these potentially valuable investigations should be explored in the full, and some form of follow up into civilian life must be contemplated and implemented.

Dr Evans has asked the questions—who will ultimately provide the answers?

#### ACKNOWLEDGMENTS

I thank Dr William Evans once a month for his assistance in pursuing the correspondence and for his continuing advice with the study. My thanks are also due to Captain L. G. Tipland, Professor of Naval Medicine for his help and encouragement.

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#### PART III: RETINAL PHOTOGRAPHY

By T. A. Law

The ophthalmoscope as a diagnostic or research instrument has one great limitation: it permits subjective interpretation only. Hence the eyes were those where the blood pressure figure was known to be correct, interpretation of ocular fundus findings is safe.

Since the arrival of the retinal camera, series of retinal films have been analysed by Kagan and his collaborators (1964) and by Jackson and Turner (1964). In both cases the series have included hypertensives and normotensives and often, have been made to assess the vascular appearance in relation to the pressure in the vessels. Jackson and Turner held the view that the measurements of arterial diameter in arterial vessels runs show nothing like the big differences that have been thought to exist from subjects ophthalmoscopically examined. Kagan and his co-workers (1964) have come to the conclusion that viewing the branches at specific distances from the disc margin is more likely to reduce which vessels are subject to the greatest pressure. Probably most retinal cameras in use today are being employed to study more pathology than normality. We found we had the opportunity to study the appearance of the normal 25-year-old male retinal circulation and to see if any particular features could be matched up with electrocardiographic anomalies and perhaps, in time, to see if any sort of forecasting was possible. The question was: what features of the normal retina should be studied?

Evans' capsule of objective measurement was considered and the following was tried:

##### 1. Measurement of Arterial Caliber

This was found to be impossible for two reasons. The variability of the optical system employed in obtaining these photographs due to the difference in dioptric power of each eye photographed and also the fact that the photographs are anything but



class in this case. Enlargement to an original diameter of almost one centimeter gives too blunted an edge to make measurement worthwhile.

### 3. Measurement of Axial Collar Height

This removes the disadvantages of the present of the optical system, but the problem of the blurred marginal margin remains. Two ways of overcoming this were considered: first, the use of microphotometer systems, or, alternatively, but the costly ones, the problem in different terms. Second, the use of fluorescent dyes. While these give a much sharper edge to the sample, they are not practicable at a 10 year old volume.

### 4. Variation of 1 and 2 using formulae for the volume of a cylinder ( $V = \pi r^2 h$ )

Hollow cylinder ( $V = \pi(r_1^2 - r_2^2)h$ ) using  $r_1$  and  $r_2$  as the limits of blurring. The objectives is, however, the same.

4. Indirect Comparison Methods using different photographs of the same feature or try the same variations in size. No significant variations could be detected using colour film without fluorescent.

### 5. Subjective Comparison

In the circumstances, objective measurements were therefore dropped and the following partly subjective features were coded from standard retinal colour photographs.

#### (a) Axial Features

Epiphyseal fusion 1

(a) None

(b) Visible closed

(c) Trapped

Epiphyse

2

(a) Striated

(b) Smooth

(c) Similar plate shown

#### (b) Oral Features

Ear Ridges 3

(a) Raised rim

(b) Flat rim

(c) Physiological Cup

Ear Margin

4

(a) Raising from ray layer or black white or stippled partial or complete

(b) Oblique entry of apical curve

(c) Ray plate obliquity

Foramen Collar 5

(a) Anterior margin

(b) Vascular full plus

(c) Vess only full plus

<b>Featural Line</b>	<b>6</b>
(a) Nucleus unduly straight	
(b) Nucleus unduly concave	
(c) Abnormality of line not covered by (a) or (b)	
<b>Branching</b>	<b>7</b>
(a) Four branches	
(b) Capless branching	
(c) Unusual branching including (b) or (a)	
<b>Featural Pattern</b>	<b>8</b>
(a) Arcades (a term used for other cat dyslexias)	
(b) Curbrows	
(c) Arcades and Curbrows	
<b>Accessory Feat(s)</b>	<b>9</b>
(a) Cilio-ventral accessory (one or more)	
(b) Other accessory feat(s) including doubtful cilio-ventral	
(c) Cilio-ventral plus other accessory	
<b>Featural Group 6/8</b>	<b>10</b>
(a) Visual Acuity 6/8 corrected if necessary	
(b) Visual entry of words	
(c) 6/8 plus visual entry	
<b>Corrected VA 6/12 or worse</b>	<b>11</b>
<b>Dolcraig Colour Vision</b>	<b>12</b>
<b>6/9 corrected</b>	<b>13</b>
<b>6/12 corrected</b>	<b>14</b>
<b>6/18 or worse</b>	<b>15</b>

Feature codes were prepared from the above code list having not as yet included any suggestive correlation with the EEG findings.

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## THE DERMATOLOGICAL HAZARDS OF TATTOOING

The following abstract of the paper has been supplied by Surgeon Captain R. W. E. Davis

*Dermatological complications following tattooing are as rare as the Royal Navy is shoreless. A questionnaire completed by 186 British demanderges, covering the period 1938-1945 revealed the incidence of analitis 17 cases of red reactions 10 green 1 yellow and 9 large reactions in which the histology was of a mixed type. Analysis of pigments supplied by a Portsmouth tattooist suggests that mercury and chrome salts are not used today as commonly as has been suggested. Local health authorities should have a responsibility not only to ensure that reasonable standards of hygiene are maintained by tattooists but also to make certain that potentially dangerous pigments are not employed.*

A preliminary report on an out-patient method of tattoo removal discussed by various talks demonstrated the effect of overexposure of Silver Thiosulfate, resulting in rejection of tattoo pigments in 14-18 days. The technique was first described by Varot in 1933, and later followed up by Day in 1935.

## CHANGING ATTITUDES TO THE DIAGNOSIS OF ASBESTOS DISEASE

By F. A. F. Macleod and P. G. Harkin

### SUMMARY

Large numbers of industrial workers in Plymouth, internationally exposed to asbestos, have been found to have pleural abnormalities. The most extensive pleural reactions often accompanied by effusions are occurring in workers more than about 15 years' exposure to asbestos. The significance of these changes in relation to the development of malignant disease is not yet known. A modified radiographic technique and the radiological appearances are described.

### INTRODUCTION

The Royal Navy has, for a long time, been aware of risk of asbestos among laggers and sprayers. What has not been recognized until fairly recently is the extent of the risk of the disease at work among civilians there. From our work at Devonport and in the other Royal Dockyards it has become apparent that large numbers of men over the last thirty years have been unnecessarily exposed to considerable amounts of asbestos.

In 1948 the late Hubert Wynn described asbestos as a disease which because of better ventilation and dust control had already reduced fatality and chronicity and would tend to become more insidious and demand higher diagnosis skill than ever.

An acceptable definition of asbestos is that it is a progressive, irreversible fibrosis of the lung due to the substance of asbestos fibre and is often but not always accompanied by pleural fibrosis or pleural calcification. We prefer to reserve the diagnosis of these cases which exhibit clinical, radiological and physiological evidence of pulmonary fibrosis following exposure to asbestos but reckon that by doing so we are making the diagnosis at a stage where considerable fibrosis of the lung has occurred. We recognize that there will be many cases presenting with apparently only pleural fibrosis or pleural calcification but who have macroscopical interstitial fibrosis. We suggest that at present these pleural changes should be described as being associated with asbestos exposure and not diagnosed as asbestososis unless there is clinical or physiological evidence of accompanying pulmonary fibrosis. We follow the tradition of thought, for the increasing number of patients with these pleural abnormalities, which cause marked restriction of ventilatory capacity without any defect in gas transfer. As more of these patients show some degree of disability it seems desirable to avoid the prescription of the (industrial) exposure due to include the most extensive pleural abnormalities in the scheme for disability payment.

The apparent change in the nature of the disease is one of the several different reasons for the changing attitude to the diagnosis of asbestososis. Wynn and his co-workers (1948), have drawn attention to the longer incubation period

of the disease following the better control of diet in asbestos factories. A similar situation exists in shipyards where there is a complete spectrum of exposure, from the sprayers and tappers who have been exposed to high dust concentrations to the large number of men who have been only incidentally exposed to lower dust concentrations.

With the longer observation period not so much is seen of the fatal rapidly progressive interstitial pulmonary fibrosis which dominated the picture 50 years ago. We are now able to see the changes occurring in the pleura accompanied by relatively minor fibrotic changes in the lung. There are increasing numbers of men between the ages of 30 and 50 with acute pleural reactions for which we cannot find an explanation or common factor other than asbestos exposure. These reactions are particularly worrying because of the uncertainty of their relationship to the possible development of malignant disease.

The problem of malignant disease has probably caused the biggest change in attitude in the diagnosis of diseases associated with asbestos. It is known that about 50 per cent of persons with asbestos will develop bronchial carcinoma. It has been suggested in America, but not yet confirmed in this country, that there is an increased risk of bronchial carcinoma in those persons exposed to asbestos even if they have not developed asbestos. There is a clear relationship between exposure to asbestos, particularly vermiculite asbestos, and the development of pleural or peritoneal mesothelioma, and it is because we are uncertain about how much exposure to asbestos is required to produce these tumours in man that our attitude to making the diagnosis has changed so radically over the last 50 years.

The significance of the changes we are seeing in the pleura is not yet known. From our experience with shipyard workers exposed to asbestos it would appear that calcified pleural plaques are appearing in the older men with long exposure to relatively low dust concentrations. Limited hyaline pleural plaques are seen in younger men but, again, after long exposure of 30-55 years. In most of these two types of pleural change there is little alteration in lung function and the men are asymptomatic. More extensive pleural reactions, which with effusions are occurring in younger men usually after about 15 years exposure to asbestos, and these are often accompanied by marked or even dietary deficits and low gas transfer factor. We are concerned about these young patients because they have longer for the disease to progress and for the development of malignant disease. We need to learn much more about these pleural changes and a long term study is being planned jointly by the Royal Naval Medical Service and the Medical Research Council to obtain as much information as we can over the next 50 years from the 20000 Dockyard employees who may have been exposed to asbestos.

#### RADIOLOGICAL TECHNIQUES

Radiology plays, perhaps, the most important part in the detection of pleural abnormalities. We suggest that the modified technique developed in the Royal Naval Hospital, Plymouth, will prove to be of value in the examination of the pleura in men exposed to asbestos.

We have investigated our patients by two methods. By routine annual large film chest survey of verified subjects in midship for more than 15 years, and then by random

factory of much larger groups of developing warblers on 100 mm film with long films of woods.

The majority of patients in an industrial survey are of heavy build and there is a considerable problem of soft tissue quality which reduces the quality of the pictures in some cases. This problem has arisen in other industrial chest surveys for example in coal miners, and various methods have been tried to reduce the scatter, such as air in the gap between the patient and the film or copper linings of the film.

The radiological study of the pleura has been very limited in the past. Our present requirement involves the detailed study of the progress of early lesions by visual survey. We must be able to record the standard PA view, lateral and 60° oblique views not adequate to display the early pleural lesions to best advantage. The lateral view will only show the development of pleura and the standard oblique is merely designed to show the fissures and the heart shadow. We have therefore developed a modified oblique view to display the pleural lesions tangentially.

We use a horizontal X-ray beam centred over the inferior margin of the scapula in the posterior axillary position. Films are taken at a distance of 8 feet without a grid which enables us to include the whole of the chest on a single film. After some experience we have adopted 45° as the most suitable oblique. A window or plastic synchroiser is useful to correct over penetration. This gives an unobstructed view of the pleural margins on the anterior and posterior axillary lines. These regions are obscured on the standard oblique by the scapula and costal margin respectively and posteriorly by the spine and scapula.

The most important diagnostic region is the space between the anterior border of the ribs and the lung margin (Fig. 1). A pleural plaque is seen as a localized expansion of this space. Early pulmonary fibrosis, not often so confined in the diamond shaped spaces between the overlying ribs posteriorly. The small segment of lung tissue between a close apposition to the film and overlying soft tissue is reduced to a minimum so that the definition is improved.

The nature of the lesions in asbestos disease demands great attention to detail in radiography. Standard processing of films is an important requirement, preferably by automatic processing. The cassette and intensifying screens have to be of the highest quality to ensure perfect contact and absence of human marks. We use normal speed screens.

#### RESULTS OF RADIOLOGICAL FINDINGS IN DISEASES ASSOCIATED WITH ASBESTOS

Pleural mesothelioma was recognized early in the history of asbestos disease and the radiological appearance may be of three types. A fine reticular shadowing predominates in the middle and lower zones of the lung fields. This type of lesion may later give rise to the crute descriptions of 'clumps', 'pleura', 'porcupine' and 'diaphragms', a nodular form of fibrosis (Fig. 2) which is much commoner in our clinical series and there may be a mixed form with nodules and reticular shadowing.

Two characteristics help to differentiate the lesions in asbestos disease from other forms of pneumoconiosis or ordinary shadowing. Firstly the nod and lower zone



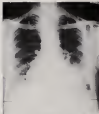


Fig. 3. Anteroposterior radiograph of the chest. Wedge-shaped opacities in the lower lung zones, pleural plaques from 1930-17. (From *Endocrine Problems in the Thorax*, by A. Chestnut, with permission, Springer-Verlag, New York, 1968.)

#### **Hyaline Plaques**

This is a contraction lesion and the presence of some of the calcified lesions. They have been discussed in detail by Kunkinaka in Finland (1966) and more recently, in 1968 by Hershenson *et al.* They consist of laminated hyaline collagen forming wedge plaques on the parietal pleura. They are usually bilateral on the sites of greatest respiratory movement—that is, on the lateral chest walls and on the anterior and posterior axillary lines. These are the diaphragms are not visible and they become calcified. Radiologically they are of low density and can be recognized by a localized expansion of the space between the ribs and lung margins.

#### **Diffuse Pleural Thickening**

This is found on the lateral chest wall, or at the fissures, and is much more difficult to recognize radiologically in the early stages. In advanced cases one can sometimes see a well-lit shadow similar in appearance to the adult thymus, and this may be seen extending from the lateral chest wall. A characteristic feature of these lesions is a clear cut margin in spite of a low radiological density.

#### **Lower Pleural Thickening**

This is found on the visceral pleura and may be in the form of sparse or fine lower thickening or occasionally as patchy, dense firm lesions. It may also be seen as



severe pleural thickening where there is some constriction of the expansion of the lung. It is possible that pleural calcification may be the precursor of all forms of latent pleural thickening.

#### Pleural Calcification

We have seen many cases with pleural calcification over the past 10 years, with or without associated pulmonary fibrosis. This leaves a certainly the interest in direct radiologically, but unless one knows the size of disease, pleural calcification can easily be missed. Pleural calcifications can be studied in serial films during its development from its earliest plaques. Minimal layer calcifications can be seen at the base of the plaques and nodular or linear deposits on their surface. The common sites are on the diaphragm (the left costal pleura), along the posterior aspect of both diaphragms on the lateral chest walls and anteriorly in the rib margins (Figs 3 and 4). The



Fig 3. Calcified pleural plaques on both pleural margins, posteriorly.

part calcifies may also calcify. Descriptions of several forms of plaques such as, scale-like, as, nodular-like, geographic or leaf-like have been given. In the early stages, calcification may be unilateral but as more extensively bilateral it is considered that it is the pleural calcification associated with haemorrhage or tuberculosis. We have been puzzled by a few patients who have massive pleural calcification and normal lung function and it is possible that other forms of dust may be contributing, for example talc pneumoconiosis.



Fig. 4. Pleural effusion. A large (moderate) effusion effaces the right hemithorax, left  $\frac{1}{2}$ , 3rd and 4th  $\frac{1}{2}$  the right and 1  $\frac{1}{2}$  the left. There has been several examples of this type of effusion.

#### **Effusions**

The most important factor in diagnosis is the discovery of a silent pleural effusion which has been seen in six of our patients who have been employed in an asbestos environment (Fig. 4). An effusion occurs first on one side, and then on the other and we have been able to observe these patients for 3 or 4 years and in one patient to 10 years. The effusions have undergone periods of development and regression and may become reabsorbed or be followed by intense lung thickening. A few cases of this type have recently been discovered on routine annual 75 mm chest films without any nasal ratings, particularly those in the region room and shipwright branch. They have all been found on follow up to have had contact with asbestos over a period of several years. Some of these patients have been working on ships during major shifts of construction.

#### **Pleural Abnormalities**

This is the most serious disease associated with asbestos, and there have been 23 cases in Plymouth in the last 3 years. In the terminal stage there is either a massive effusion or diffuse bilateral pleural and pericardial thickening.

#### **SUMMARY**

A large number of patients with pleural abnormalities have been discovered in Plymouth, and in the light of our experience we expect that many more have yet to be

separated. There is no real (and just) no, problem will be to cover the program in these classes.

The modified oblique (wing) is useful to display the glenoid fossa adequately. The standard (May) is in direct (May) film. Right and left obliques may be required.

We would like to suggest that glenoid exposure should be considered in the differential diagnosis for one person over the age of 50 with an unexplained effusion.



Fig. 1. Anteroposterior (AP) radiograph of the shoulder joint showing a subacromial effusion (fluid collection).

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## ALCOHOLIC PSYCHOSES

By David H. Margot

## ABSTRACT

The study of alcoholic psychoses in *Servicemen* shows the clinical picture is far more varied than is usually believed and that they have much in common with other drug states.

The 'physiological' and 'metabolic' theories of alcoholic psychoses receive official support; the theory of the toxic which can produce physical dependence is not widely accepted.

Alcoholic psychoses not only conform to the classic organic psychosis types, but may also resemble cataplexy.

## INTRODUCTION

Alcoholism is a hazard of Service life and psychoses are seen regularly. Patients are seen as young as 18 years of age and one third of Service patients with alcoholic psychoses are under 30.

Alcohol plays an important but not necessarily essential part in Service life. Its functions include:

- i To explain euphoria
- ii To promote mutual social intercourse and facilitate group solidarity
- iii To impart the sweetness of the passage of time, or to avoid boredom
- iv To be disinhibited and to feel free for a space of time of the necessary constraints of a disciplined Service

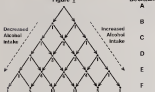
The exact reason why some who come into contact with alcohol take enough to damage themselves is not clear. It may be that the question 'why do people drink?' is inappropriate. Possibly the increased chance of contact with alcohol is to become addicted. Perhaps the question to be asked is 'Why do people not drink?'

It is possible to use a simple mathematical model to illustrate this. In 'Pascals' Theorem' imagine each person who takes alcohol has a series of chances. Each decision has the effect of reducing or increasing the odds of alcohol.

Then a statistical approach to these problems is possible. There will of course be a chosen curve if the chances are not equal and if the additive properties of the drug alcohol make an influence felt.

This simple approach is complicated in *Servicemen* by the influence of emotional or customary factors, exemplified by the sailors' 'reef salute'. As the length of a drinking bout required to produce physical dependence is less than 14 days (August 1964, *Accompany and Notes*, 1965, *Notes and Notes*, 1965, *Margot 1970*) a number of *Servicemen* who are not regular heavy drinkers become dependent. However the typical story in Service patients, whether regular or binge drinkers is of a short

Figure 1



spell of very heavy drinking, followed by sudden abstinence, immediately provoking the onset of the psychosis.

#### THE AETIOLOGY OF ALCOHOLIC PSYCHOSES

In *Sereno* patients, then, the typical story is of the onset of a psychosis within 72 hours of the abrupt withdrawal of alcohol, after a bout of very heavy drinking. Over 70 per cent of psychotic alcoholic *Sereno* patients give such a history (Mager, 1970).

There is extensive clinical (Victor and Adams, 1955; Johnson, 1964) and experimental (Pott, 1961; Fraser, Widler, Redville and Trueman, 1955; Mendelson and La Cour, 1964) evidence that alcoholic psychoses— including delirium tremens and even fits—are due to sudden abstinence after a period of very heavy drinking. The critical dose of alcohol is, probably between 250–300 grammes of alcohol a day (Lofell, Fraser, Widler, Redville and Trueman, 1955; Mendelson and La Cour, 1964). The critical length of heavy drinking provoking an alcoholic psychosis is much shorter than is usually thought, and is probably less than 34 days (Agostini, 1964; Agostini and Nelson, 1965; Victor and Adams, 1955; Mager, 1970). Of course, there is considerable individual variation and perhaps only a few of those taking just the critical dose for only the critical time will develop a withdrawal psychosis. The following hypothetical grid illustrates this (Mager, 1970).

Psychosis and its sequel on abrupt withdrawal after developing physical dependance occur on barbiturates and other drugs (e.g., alcohol, barbiturates, Reserpine, Fluoxetine and Prozac, 1950; Eng, 1964; Wolff, 1969). Both drugs and alcohol can be withdrawn too, for the other which accounts for chronic alcoholics who chronic barbiturates and sedatives. Dependence may be to multiple and numerous drugs,

Properties (%) of population due to withdrawal alcohol psychosis

Days of alcohol intake	Time (days)							
	1	2	3	4	5	6	7	8
100	0	0	0	0	0	0	0	0
75	0	0	0	0	0	0	0	0
50	0	0	0	0	0	0	0	0
25	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0
-25	0	0	0	0	0	0	0	0
-50	0	0	0	0	0	0	0	0
-75	0	0	0	0	0	0	0	0
-100	0	0	0	0	0	0	0	0

Table Modified from  
Jaffe and Jaffe (1964)

including alcohol. It is also significant that EEG changes similar to those caused by the withdrawal of alcohol and opiates are caused by the withdrawal of amphetamine and related substances (Gerschlager and Thurner, 1967). It may be that amphetamine causes psychoses or withdrawal psychoses. While it is usually held that withdrawal of barbiturates and other sedative drugs can produce a psychosis identical with delirium tremens, other syndromes resembling alcoholic psychoses, acute hallucinosis and stages of deliriousness occur, have also been seen by the writer in drug withdrawal states other than due to alcohol.

Recently (Morgan, 1968) it has been suggested that other factors associated with withdrawal, or delirium tremens, produce the form of alcoholic psychosis. This is not supported by clinical evidence from German patients (Morgan, 1970). In these patients delirium occurs from acute alcoholic hallucinosis and delirium tremens, and from delirium tremens into a subacute hallucinosis. Patients can show a different psychosis, reaction to numerous episodes of withdrawal.

#### SUPERSENSITIVITY MODEL OF EFFECTS OF DRUG WITHDRAWAL

Perhaps the most convincing model of drug dependence is that put forward by Magnus and Jaffe (1966). They suggest that withdrawal phenomena are due to the development of supersensitivity due to disease caused by pharmacological deterioration. It is postulated that with the loss of neurosensory post-synaptic receptor sites increase in number and when pharmacological blockade ceases, there is overactivity at the synapse and homeostatic processes produce equilibrium again.

Such a process is demonstrated in the peripheral nervous system for opiates (Paton 1958; Morin 1964) and other drugs such as Cocaine, Chloroform, Maltolol, thalothal, barbiturates and methyl pentonol (piperidine, 1965). While such a process reduces the output of withdrawal, it is not merely an acute reaction when blockade ceases that produces synaptic overactivity.

The effect of barbiturates on producing supersensitivity in the CNS has been studied by Magnus and Jaffe (1963, 1964) and Erug (1967). They showed that while the nerve is involved in withdrawal contractions, it is not essential to their production. More the contractions or opiate anal. It is suggested that the reticular activating system is mainly affected. Such supersensitivity shows the following characteristics:—

- (1) The first dose produces a considerable effect

- (2) It approaches a maximum slowly and has reached  $\frac{1}{2}$  of final level after two weeks.
- (3) It is reversible in less than a week.
- (4) The time course and effect of protein synthesis inhibition suggests that protein synthesis is involved (Clyne and Gendreau, 1969).
- (5) The effects of the CPM appear to persist for some time after withdrawal, or super-sensitivity is more easily re-induced.

While there is no direct observation of changes in protein synthesis or of structural changes in nerve cells, short-acting barbiturates induce changes in liver cells in the endoplasmic reticulum, increased with the more rapid metabolism of short-acting barbiturates (Kornmeier, 1966).

Some effects of drug dependence, particularly 'psychic' dependence, are best explained by the model of two systems in the brain, one of which is concerned with reward and the other with punishment. The reward system is located in the medial fore-brain bundle and the punishment system in the periventricular fibres. These systems would integrate if cross-inhibition occurs between them. Thus, activation of one or inhibition of the other would have comparable effects. Reduction of drive as an effect of the drugs could be explained by their effect on the reward and punishment systems, and eventually on an internal drive to super-sensitivity to the drug. It appears that amphetamines may block the inhibition of the reward system and barbiturates block activation of the punishment system (Cohen, 1969). However, with the demonstration of suppression of REM sleep by barbiturates, ethanol, amphetamines, opiates, anti-depressants, etc., and the rebound of REM sleep on withdrawal (Quessid, Levetz and Lewis, 1966), one need no longer talk of psychic and physical dependency. Many drugs induce changes in the central nervous system with a variety of withdrawal effects. But only some, perhaps very few, pharmacological effects, both in action and withdrawal, are shared by depressant and stimulant drugs and the wide variety of other effects obscures the effects they have in common.

#### SIDES OF DRUG ACTION

The exact site of action of drugs is a matter as yet of some speculation. Several hypotheses are entertained. There are not of course mutually exclusive.

##### Disturbance of Metabolism of Biogenic Amine

###### (a) Cerebellosum

Observations of the effects of extra-ventricular injections on the behaviour of EEG of animals support the punishment and REM sleep is the result of the interplay of a cerebellosum dependent reward system and a serotonin dependent sleep system. Thus, it is possible, but not yet demonstrated, that disturbance of monoamine metabolism in the system could affect dreaming.

###### (b) Serotonin

Feiler (1964) has suggested that dreaming is, at least in part, an expression of the reward (and satiety?), components of processes related to memory storage and

and several. Such processes appear to be kept from conscious awareness through inhibitory processes affected in their activity by the hippocampal structures. For example, an LSD episode alters memory. The pathway involved is diffuse efferent activity ascending through the hippocampus via ephoroprecuneate fibres across the dorsal medial nucleus of the cuneus (Blompl 1967). These waves, which come from an oscillating depth across the pyramidal cell bodies and the dorsal regions of their apical dendrites (Blompl 1965; Andersen 1966). When the synapses of the pyramidal cells and their axon collaterals are supported by the basket cells, their activity represents activity that is mainly inhibiting (Andersen, 1966). The hippocampal synapses are cholinergic (Papas, 1966). Under physiological conditions acetylcholine and serotonin are stored in the hippocampus in the same presynaptic terminals (de Rubeis, 1964). Serotonin is released into the presynaptic extracellular space. The excess serotonin transport into the extracellular space, inhibiting the activity of acetylcholine. A reduction in this activity and repeated material from memory stores including awareness of stimuli.

An experience is taken up again into presynaptic storage sites, the inhibitory effect of acetylcholine with increased state activity reduces learning.

This appears to be a self-perpetuating activity but potentially able to be disrupted by drugs, *ie.* LSD, possibly by perverting the signals of serotonin and thus current pathological learning. This may in part account for the hallucinatory effect of LSD.

These neural mechanisms are discussed later in this paper.

### (c) Alcoholism

The role of acetylcholine in alcohol addiction has been well reviewed by Martin (1966).

It has been shown that ethanol is metabolized to COA before it takes part in further metabolism, by the use of radio isotopes (Raywell and Van Bruggen 1964). However alcohol also reduces the formation of COA in liver homogenates (Kumon 1965; Nagai 1964). It appears that alcohol interferes with those pathways needed for its own metabolism and also blocks a competing pathway.

Acetylcholine is a neurotransmitter in the brain, including the reticular activating system and the long term effects of alcohol on acetylcholine metabolism may be in part, responsible for the development of dependence. As the quantity of acetylcholine falls, its receptor sites will increase (Sharpley and Jaffe, 1967). Thus drugs which prevent or reduce the liberation of a neurotransmitter from the nerve endings, as well as drugs which can block adrenergic or cholinergic receptor sites in the effector organ, produce a state of supersensitivity in effector organs which resembles that caused by denervation. A striking parallel exists between the sensitivity of effector organs which have been subject to prolonged pharmacological blockade and the withdrawal syndrome after prolonged administration of CNS depressants, and it may be that physical dependence is a manifestation of pharmacological supersensitivity in the CNS (Emswiler 1964; Sharpley and Holgers 1963; Jaffe and Sharpley 1965).

The withdrawal of alcohol would remove the block to COA and thus to acetylcholine synthesis. The additional reduced receptors are relatively stable and do not



decrease rapidly. The result is hyperexcitability. Such symptoms may depend on protein synthesis. (Grueter, Gross and Loren: 1961) or glycine inhibition (Hodoff: 1961; Majum: 1962).

Anticholinergic may function by —

- (1) Antagonism of an SH group at the receptor site
- (2) Anticholin by hydrolysis
- (3) Alkylating function
- (4) Formylation modification
- (5) Interference or fixation of other neurotransmitters
- (6) Modify metabolism of other neurotransmitters
- (7) Other processes

Perhaps the reduction of receptor sites is due to glyoxylic acid. Glyoxalic could play a role in this connection (Aldrey, Taylor and Hirstly: 1964). If the inhibitory action of histamine on RNA was reduced as means of protein synthesis of the (GABAergic) receptor sites might occur and alcohol or one of its metabolites might inhibit histamine and de repress RNA.

The work suggesting that gamma amino-butyric acid (GABA) metabolism is affected in alcohol and similar dependence may complement the work on anticholinergic. Anticholinergic may be a specific neurotransmitter of GABA as a more potent regulator of CNS excitability. Changes in one or the other could affect the same nerve cells and their synapses. But, theories of the action of alcohol must also encompass the effects of barbiturates and pharmacologically similar drugs, as they all appear to produce similar symptoms on withdrawal after physical dependence is established and all have many of the properties of general anesthetics.

#### (d) Gamma-Aminobutyric Acid (GABA)

In 1950 it was reported that enzymes and inhibitory factors could be isolated from mammalian brain (Hess: 1950). The inhibitory factor was progressively identified with gamma amino-butyric acid (GABA) (Jelliffe: 1958). In the vertebrate GABA is converted to the CNS and has a wide and relatively even distribution from about 150 mg/g in the cortex to 200 mg/g in the midbrain.

GABA is formed from glutamate or  $\gamma$  by an essentially irreversible action involving glutamate decarboxylase with pyridoxal phosphate (PLP) as a co-factor. GABA undergoes a transamination reaction with  $\alpha$ -ketoglutarate, acid, resulting in the production of succinic anhydride, which itself can be continuously oxidized to succinate and. The transaminase also requires pyridoxal phosphate as a co-factor but the enzyme is not confined to the brain. Even if GABA does not possess a neurotransmitter function, it occupies a unique position in the metabolic systems of the brain.

In the cerebellar mossy synapse GABA mimics perfectly the actions of the putative inhibiting transmitter substance, causing an increased membrane permeability to potassium and sodium ions. It is possible that GABA does occur in mammalian nervous system (Kuffler, Ruffner and Potter: 1963). However, in the vertebrate nervous system GABA does not appear to antagonize the actions of acetylcholine in the spinal cord. But, experi-

neuron in the cerebral cortex suggest that GABA has such a role (Kempson, Bandler and Humphrey, 1966).

Alternatively GABA may regulate the water permeability of the parts of the CNS. The convulsant hydantoins cause, in experimental animals, spontaneous central water or neuronal susceptibility to anoxogenic and physically reduced neurons. A similar tendency is noted with patients on no anoxenic and hydroxide for anticonvulsants. These hydantoins cause a loss of pyridoxine from the body and hydroxide anoxogenic in experimental animals are associated with a large reduction in the brain's GABA content (Kempson and Bost, 1967).

Hydroxide anoxogenic can be prevented by the administration of pyridoxine (Flory, 1966) and by hydroxylation, which reduces GABA's own plasma concentration (Roberts, Bost and Eidelberg, 1966). Other compounds, eg. picrotoxin which causes pyridoxine deficiency, also produce anoxogenic and hydroxylation will protect animals against agents such as ligand which do not deplete brain GABA. Animals given theoxanthine and hydroxylation will show an increased susceptibility to anoxenic even though brain GABA content is higher than normal (Roberts and Eidelberg, 1967) while the hippocampus which has the highest content of GABA has the lowest anoxic threshold (Roberts, Bost and Eidelberg, 1966).

Anoxenic made dependent on barbiturate develop for the brain's anoxenic on withdrawal, an increased susceptibility to anoxogenic neurons (Chandler and Leonard, 1965). These can be prevented by anoxenic agents and, which like hydroxylation increases brain GABA content (Flory, 1965, 1966). However, anoxenic can occur in the presence of elevated brain GABA, but there are alterations in GABA levels in barbiturate dependence. Anoxenic agents need data not protect against elevated withdrawal convulsions *in vivo*, although GABA levels are raised.

GABA itself is a metabolically active way with glucose and, which has a general excitatory action on neurons (Curtis, Phillis and Watkins, 1966). It may be that the ratio between GABA and glucose and/or glucose is a important (Chandler Ellis and West, 1967).

The study of subcellular distribution of the enzymes related to glutamate neurotransmission supports the view that acetylcholine, in such a compound and hence support the neurotransmission and anoxenic. Glutamate decarboxylase appears in the cell fraction of nerve endings, which lack the acetylcholine system. This supports a possible inhibitory role for GABA (de Roberts, 1964).

Roberts (1966) proposed that changes in the probability of information exchange at a synapse may be equated with changes in distance or conductivity between the presynaptic and postsynaptic elements. He suggests that the presynaptic liberation of a neurotransmitter immediately leads to the liberation of a synaptic feedback, postsynaptic inhibitor. Glutamate is an excitatory and is suggested as such an inhibitor.

- (1) GABA shows some of the properties expected of such a substance.
- (2) GABA is formed and metabolized in the CNS.
- (3) Components of the subcellular GABA system are localized in the subcellular fractions associated with nerve endings.

- (6) GABA inhibits at both pre- and postsynaptic levels, so may act as the postsynaptic inhibitory substance.
- (7) GABA affects eye conduction in a manner consistent with inhibition.
- (8) There is a time-dependent binding of GABA to neural substance.

#### THE PHARMACOLOGY OF DREAMING

##### *Drugs and Drugs including Alcohol Addition*

The discovery that dreaming was associated with conjugate rapid eye movements has led to the definition of the sleep-dream cycle (Aserinsky and Kleitman, 1951, 1944). The sleep dream every 90 minutes approximately during sleep (Dement and Kleitman, 1957). The dream is the psychological aspect of widespread activation which includes conjugate rapid eye movements, autonomic irregularities, a decrease of postural muscle tone, periodic chest and an emergent Stage I EEG characterized by low voltage fast activity free of spindle.

The first dream of the night comes on about 1-2 hours after sleep onset and the dream periods vary from 15-60 minutes in length. The dream cycles grow longer as the night progresses. An adult spends 20-25 per cent of his time asleep in the dream state when subjects are woken during a period of rapid eye movements (REM), the chances of recall of dreaming are 60 times greater than if awakened in non-REM sleep (Aserinsky, 1945).

Because of their quality, Snyder (1963) has called this state of the organism the third organism state. As far as it is not all organisms sleep REM sleep in non-humans animals including humans the percentage of REM sleep is high and approaches 30 per cent in the animals.

It has been shown by brain-sections of the brain at various levels and by electrical stimulation, that a centre in the ventral pons (locus coeruleus nuclei) is responsible for the activated (REM) state. While this centre is active it is not necessarily part of the conscious activating system.

Dream deprivation, brought about by disturbing the subjects at the onset of a period of REM sleep, led to an earlier onset and increased frequency of REM sleep (the REM rebound). Such subjects after several nights, showed increased anxiety and shortly resumed increased irritability and heavily increased concentration, memory and motor co-ordination. Using phasic stimulation there was a heightened tendency to experience hallucinations. Such findings do not occur in every subject however, and there are wide variations in individual vulnerability (Dement and Fisher, 1963; Fisher, 1965).

Total deprivation of sleep for over 100-150 hours can produce an acute psychotic picture. Psychotic episodes in sleep-deprived subjects show a cycle of 90-120 minutes and suggest that the dream-like hallucinations are breaking through into waking life because of the REM deprivation associated with total sleep deprivation (Czeisler et al. 1980; Dement and Fisher, 1963; Bergmann et al. 1948). Total REM deprivation was achieved in rats by destroying the posterior triggering centre. Cats can lead for 30 days and become exhausted and died in a state of rage. Other cats showed hallucinatory-like behaviour (Morris, 1962).

White-noise-induced REM changes are not found in schizophrenic, nor in depressed patients sleep-deprived (sleep state) nor in a reduction or exacerbation of the psychomotor release pharmacologically deprived of sleep (Kornhuber and Lohmann 1966).

#### *Drug Effect on Sleep*

The phenomenon, at least on chronic administration, shows a reduction in REM sleep, but it is clear (rebound effect) (Faulberg 1964) Reserpine is said to cause an increase of REM time in man and, a decrease in cat. It is concluded (Witelson 1964) that the suppression of REM sleep is allied to the antidepressant effects of the drug.

The reports of the effects of LSD and other hallucinogenic drugs are confusing but the balance of evidence suggests an increase of REM sleep (Guzin, 1967; Watson 1966).

It has been suggested that sedative drugs cause —

- (1) immediate escape from reality
- (2) REM sleep suppression
- (3) On withdrawal REM sleep rebound

If correct, drugs which do not have the first action may have the other two. Thus whilst they would not be subject to drug abuse, they may well be used in therapeutics. Alternatively, some drugs that allow escape from reality may not affect REM sleep.

The REM rebound that occurs after drug withdrawal is not entirely comparable to that after sleep or REM deprivation. After REM deprivation the deficit is not fully made up. In fact, only about 40 per cent of the lost REM occurs within 3-5 days, before sleep returns to normal (Dement, 1965).

However, after the chronic administration of drugs, the rebound of REM sleep exceeds that lost (Kiwaki 1966). Thus, it is more than mere compensation and shows such as release of pent-up activities are postulated (Dement 1965).

The course of recovery of the sleep pattern is similar for a variety of drugs: amphetamine (Kiwaki and Tinsome, 1965), short-acting barbiturates (Donald and Pratt 1965, Evans *et al.* 1966) or heroin (Lowe *et al.* 1965). However, the rebound after amphetamine depresses more 3-5 days after withdrawal, whereas for amphetamines, barbiturates and alcohol it is less than 12 hours. A similar effect that of withdrawal has often in some types of hallucinosis and other drugs, had been noted (Kilmerovitz 1942). For some after withdrawal of short-acting barbiturates, but they are much less frequent after more long-acting and more slowly cleared barbiturates. The rate of elimination of a drug affects as the withdrawal syndrome. The more rapid the elimination of the drug, the more forced the withdrawal manifestations. Thus the withdrawal of alcohol or short-acting barbiturates may precipitate delirium tremens and fits, whereas the longer acting barbiturates and depressants may only lead to increased REM and increased, possibly bad, dreams.

During REM sleep the profusion of eye movements is related to the dream content. The greater the profusion, the more active or vivid the dreams (Dement and Wilson, 1959; Berger and Green M. 1965). Barbiturates decrease both duration of REM and profusion of eye movements (Kiwaki *et al.* 1966; Bickelind 1967). When barbit-

or other treatment or withdrawal are withdrawn. The problem of non-response may arise, for this, first (Gould, Evans and Lewis, 1965) after withdrawal withdrawal REM sleep including vivid, frightening dreams (Hogel and Price, 1966; Wolk, and Dement, 1967; Kales and Latham, 1968; Evans *et al.* 1968). Similar effects are seen in alcohol withdrawal (Gross *et al.* 1966; Grossberg and Poulos, 1967; Bragman *et al.* 1969) and neurophysiologic withdrawal (Le Gross, 1965). Increased dream awakenings also accompanied REM rebound following REM sleep deprivation by behaviour techniques. Such dreams may have a novel content (Gould, Evans and Lewis, 1965). Sexual responses including penis erections are part of the REM state. It may be that the hypnoid and often frightening novel content of post-withdrawal dreams is a REM rebound phenomenon.

Alcohol has a depressant effect on REM sleep in normal individuals (Grossberg *et al.* 1965). A 40 per cent REM loss was noted in dream diaries for up to a week after withdrawal, which equaled 100 per cent at the onset of DT's (Grossberg and Poulos, 1967). The breakthrough of dreaming into waking life, a marker of one organism, states, gives the picture of the alcoholic psychosis.

The period of 4-6 weeks required for the REM loss to return to base level suggests processes associated with the protein turnover time scale within the CNS.

It may be that the increased receptor sites caused by pharmacological blockade (Sharpe, 1964) are of a protein nature. There is synthesis of new ones and an adaptive (potent) develops together with physical dependence. On withdrawal of the blocking agent, hypersensitivity occurs with rebound over release. Depending on the rate of clearance of the blocking agent after stopping administration, local homeostatic mechanisms are less effective. The more rapidly the agent is disposed, then the clinical and pathophysiological and psychological picture will vary in intensity and nature. After 10-14 days, the more acute dysphoric effects, jump with the establishment of local homeostasis and then with the natural decay of receptor sites due to protein turnover and their replacement in the job drug level, phenomena such as increased REM sleep take over.

#### THE EXPERIMENTAL PRODUCTION OF ALCOHOLIC PSYCHOSES IN MAN

Until recently the general view was agreed that the alcoholic psychoses including alcoholic hallucinosis and delirium tremens, were due to the abrupt withdrawal of alcohol. This in spite of the frequent observation that very similar states were seen after the abrupt withdrawal of barbiturates and other hypnotics. Certainly the non-withdrawal theories of alcohol presented in the USA. An alternative theory was that all alcoholism was symptomatic of, or secondary to, other mental disorders. These theories were less widely held in Europe (Jellinek, 1968).

Thus, Jellinek *et al.* (1955) carried out prolonged experiment of intoxication with large quantities of alcohol on volunteer subjects from morphine addicts who had been withdrawn from morphine. They were ten healthy male adults, who had been abstinent for at least three months. They were to be kept in a state of intoxication compatible only with sedative management for 4-10 weeks and then to discontinue alcohol

abruptly. The alcohol was given at regular intervals over the 24 hours including a drink at midnight and 1 or 2 am. They received a dose of 200-600 grammes alcohol per day. No untoward or distress occurred while the subjects were receiving high blood levels of alcohol. Five patients withdrew after drinking for 24 days or less. These experienced withdrawal symptoms: tremulousness, nausea, perspiring and awareness of heart beatings. Six of the patients drank from 40-57 days. On the abrupt withdrawal of alcohol, all developed tremor, marked weakness, nausea, vomiting, diarrhoea, hypotension, fever and hyperreflexia. Two of these six patients had serious effects of these but a final distress was seen when receiving large doses of barbiturates for sedation. Two had secondary visual or aural hallucinations and the one patient vomited both emetics and psychics. These phenomena occurred despite an adequate diet and various applications during the period of convalescence.

They believed that the intensity of symptoms was roughly correlated with the quantity of alcohol consumed per day and the length of time at that consumption.

The blood alcohol was surprisingly low, while the intake was between 500 and 775 grammes a day; the level was less than 50 mg per 100 ml. However, with elevation to between 500 and 775 grammes a day (depending on the individual) there was a rise of blood alcohol to between 100 and 240 mg per 100 ml with evidence of marked intoxication. When the dose which usually caused high blood alcohol levels was maintained the intoxication in the blood fell sharply and eventually approached zero. A small increase in the dosage and a change in the schedule of drinking was followed by a second elevation in the blood alcohol which did not fall until alcohol was withdrawn.

There was no evidence of cerebral damage three months after drinking was discontinued.

A similar experimental study was carried out by Mandelkow *et al* (1954). They gave a mixture containing 40 per cent alcohol every four hours. The dosage schedule was so arranged that at the end of five days all the subjects were taking 50 g or 1.53 per day. Such a dose was to be continued for 10 days and then increased to 40 g or 1.08 a day for the final six days of the experiment. The schedule therefore gave up to 240 grammes alcohol per day for 10 days and 417 grammes per day for the last six days. At the end of this time alcohol was abruptly withdrawn.

In the clinical experiment six patients managed to take the full 417 grammes of alcohol daily for the last six days. In fact the alcoholic intake and symptoms can be summarized as follows for the last six days:

Subject	Total intake		alcohol a day
	g	oz	
1	430	15	1.7
2	360	12	1.4
3	370	13	1.5
4	325	11	1.3
5	360	12	1.4
6	370	13	1.5
7	370	13	1.5
8	360	12	1.4
9	475	17	2.0
10	350	12	1.4

All of these patients developed withdrawal symptoms and cases 1, 2, 3, 6 and 8 developed hallucinatory states.

One is based on a pilot plan that all future papers compare high dosages to the previous maximum, scaled scale. To use such criteria, subjects in fixed doses must remain stable rather than produce the active tolerance, before the scaled standard value is understood below withdrawal symptoms. In the two papers quoted (Jellil *et al.*, 1953, and Johnson *et al.*, 1954), the present writer calculated the dosage as follows:

These findings demonstrate that a daily intake of alcohol in excess of 100 grams, a day or (quite or less) withdrawal symptoms and in excess of 150 grams a day to a withdrawal psychosis and/or fix in the majority of subjects.

The time needed to become so dependent is not clear, but the experiments suggest that only a few days at the higher dosage after some time at the lower dose will lead to psychosis and fix (Johnson 1951). These findings fit so well with the clinical observation. One study of men, who were withdrawal states in the British Forces when the subject is taking over 4 bottles of spirit a day, or 250-300 grams alcohol a day or 12-14 parts of strong beer a day or 100-150 grams alcohol a day.

Both Johnson *et al.* (1954) and Jellil *et al.* (1953) noted the development of acute emotional disturbance superimposed on intoxication at the same subjects at each stage.

Johnson reports that one patient became progressively more dependent and self dependent to 150 grams alcohol/day. Another patient, after consuming 150 g alcohol/day for 7 days became very disturbed, had delusions of persecution and ideas of reference. When the dosage was reduced to 200 g alcohol/day, his symptoms remitted and he appeared merely as a slightly unbalanced individual.

Jellil reports that four patients withdrew from the trial. One withdrew because after 20 days only he became progressively more depressed and he stopped drinking voluntarily on the 24th day.

These well-executed experiments raise very interesting questions. It appears that chronic intoxication can lead to marked 'dependent' symptoms and in particular confusion. However, not dependent states are also seen during the withdrawal phase. It may well be that a subject who is disturbed by emotional distress may stop drinking and this could lead to a withdrawal psychosis. It may be that there are two separate symptoms and the one is alcoholism intoxication and the one due to withdrawal are regarded as one reaction. They may only lead to neurological and psychiatric confusion. Johnson (1951) suggested a simple observation when symptoms show deterioration.

Intoxication	Withdrawal
Intoxication may be	
(1) Pharmacological	(1) Tremulous State
(2) Advanced	(2) Acute Delirium
a. with psychotic reaction	(3) Delirious Features
b. with emotional reaction	
c. with alcoholic features	

Jellil *et al.* (1953) carried out the experimental chronic barbiturate intoxication of 5 volunteers who were alcohol and opiate addicts. A high enough dose of short-acting barbiturate was given to give the marked intoxication. This was kept up for 74 to 114 days. The subject maintained five patients developed fix between 80 and 115 hours after withdrawal. Four of the patients including the one that did not develop

his had a hallucinatory population, observed with objective frequency. The psychosis developed on the fourth night or fifth day and in these patients was preceded by a night or two of sleeplessness. In the latter group it started on the third day after a hit.

Three of the patients who developed a withdrawal psychosis experienced delirium and hallucinations of a persecutory nature.

During the period of chronic intoxication, three of the five patients had episodes of delirium with requirements of report were noted from the patient because withdrawal and methods pursued, knowing that other patients did not like him and that the treatment favored safety and claim of inference were apparent.

The clinical validity of both series and other withdrawal psychosis and alcoholism status such as delirium tremens has been pointed out by Katsenelson (1941), among others, and appears to have been with a wide range of hypnosis and sedation.

It appears from experimental work on chronic intoxication with alcohol and similar drugs characterized that while some, and behavior shows loss of control and control and deterioration in control, patients do become depressed and paranoid while intoxicated. This was clear on reduction of or stopping of the drug and the validity of the situation is not affected if a withdrawal psychosis occurs later.

The clinical history was experimentally during the stage of chronic severe intoxication the confusion, impairment of thinking and falling off in efficiency in any work, or skilled under aspect of person variability and mood lability, dysphoria, myoclonus, ataxia, edema, depression of superficial reflexes, full injury occurs usually due to falls, but leads from experience and danger of falling lies in beds with exposure to exposure.

A significant number of patients experience a depression or persecutory nature without the psychotic features.

#### *The Withdrawal Phase*

The clinical findings of withdrawal show hyperreflexia, tremulousness, violence, anxiety, vomiting, hyperkinesia and incoherence, anxiety and apprehension, weakness, hyperreflexia and fever.

In most severe cases a hallucinatory psychosis, usually of a persecutory nature, occurs with variable deterioration for time and place, but can persist. This also occurs.

Withdrawal symptoms usually start up in 3 days, but in a number of instances the delirium preceded and some signs had to be taken to read it on the patients were severely exhausted and a finding could have occurred.

### CLASSIFICATION OF ALCOHOLIC WITHDRAWAL SYNDROMES

The recognized syndromes are:

1. Tremulous reaction (the shakes)
2. Delirium Tremens
3. Acute alcoholic hallucinations



4. Abnormal postures
5. Grand mal epilepsy (rare but)

but in practice mixed "episodes" or subacute hallucinatory states make up the majority.

From studies of German patients, it seems better to regard psychotic behavior as being made up of "symptom elements" which can be combined in any permutation or combination, viz.

1. Catatonic motoric derangement or mutism and waxy rigidity
2. Vasomotor and other autonomic disorders
3. Tremor
4. Affective changes: tears, enthusiasm, anger
5. Perceptual distortions including illusions
6. Hallucinations
  - Visual
  - Auditory (classically third party conversations when the auditory horizon is intact)
  - Tactile
  - Olfactory
  - Gustatory
7. Disorientation or delusional convictions
8. Clinging of consciousness
9. Agitation
- (10) Symptoms for psychosis
- (11) Grand mal fits

Disorientation of behavior can occur in unimpaired subjects (Jelliff *et al.* (1934), Mendelsheim *et al.* (1944)) and this must not be confused with the catatonic symptoms.

Some features of the psychosis may cause confusion. Triggers may be, so elusive as to be invisible, or even change into epileptic and that may precede a grand mal convulsion. Patients may be not confused at disorientation often fail to report hallucinations, but they can readily be detected by direct questioning. Such patients usually have caught into their inspiration. The auditory hallucinations can be persistent and live for weeks. They was clearly recognized by Bleuler (1911). Often such patients are labelled cataplectics.

Often, run by one from delirious features to hallucinations and vice versa. Also a patient can have one type of psychosis on the first occasion and subsequent psychotic episodes are different in kind. Furthermore, German patients who have taken a critical dose, of alcohol for at least the critical time, may show symptoms usually held to be diagnostic of schizophrenia (cf. Schneider's first rank symptoms):

1. Aural life thoughts
2. Voices heard arguing
3. Voices heard commenting on one's actions

4. Experiences of influence playing over one's body
5. Impulsive drives and external acts taken to be the work or influence of others

Schneider does point out that such symptoms occur in psychosis other than schizophrenia. Alcohol could therefore be shared with those drugs such as amphetamines and barbiturates which can give rise to 'compulsive schizophrenia'.

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## SESSION III

## Research and Reports

Chairman: Professor R. S. F. Schilling

BONE NECROSIS. — AN OCCUPATIONAL HAZARD OF  
DIVING

By D. H. THOMAS and J. A. B. HARRISON

## SYNOPSIS

Ample bone necrosis occurs in naval divers and has been found in sport divers even. The incidence is much lower than in other published series. The results and implications of a retrospective survey of 259 naval divers are discussed and radiological features and techniques are described.

## 1.—The Clinical Aspects

For more than 2,000 years man has been able to prolong his existence underwater beyond the limits of breath-holding with the use of primitive devices of breathing apparatus. (Aristotle 383 BC; Pliny 77 AD). It was not until the development of the oxygen helmet in the early part of the 19th century (Davy, 1803) that man was able to dive to depths as great and for durations so long that he put himself at risk by absorbing a quantity of gas in his tissues which he was then unable to eliminate during a rapid return to the surface. It is, in fact, just over 100 years since Dr Alphonse Gial accompanied a Greek sponge-diving expedition and later described (Gial, 1872) what would seem to be the first reported cases of decompression sickness in divers. Since then it has been one of the principal objectives in the particular field of occupational medicine to calculate the ideal series of decompression stoppages which will enable the diver to return to the surface without suffering from the consequences of excess tissue gas and the formation of tissue bubbles.

Farther this year a dive to 4150 feet on the S.N. Deep Trawl Unit (Haldane, 1946) established the apparent safety of deep diving so what was the deepest occurrence in water that has yet been made by man. Thus, in spite of occasional cases of decompression sickness the great majority of which respond to treatment by recompression, it would seem that no limit has yet been defined for man's potential penetration of water space. Although the limit for depth may be imposed by the direct effects of hydrostatic pressure, by nitrogen narcosis (Brown, 1955) or by nitrogen toxicity (Chernick, 1955), it is becoming apparent, as has been stated already (Hess and Harrison, 1959), that the ultimate limiting factor is not decompression and that to safe diving operations may be that due to the so-called 'oxygen toxicity'. Whether from very deep oxygenation diving or from shallowly compressed air diving it is possibly

that bubble formation may often occur without progress to such (local) damage while insufficient to cause any noticeable symptoms.

Whether the acute manifestations of decompression sickness can be recognized easily and treated successfully is already accepted; that there may exist long-term pathological effects on decompression which do not cause an acute form of the disease is remains possible; that these may not be due to hyperbaric bubbles but due to some other pathological phenomenon such as lipid crystals. The possible sites of such malaise, silent damage include two areas of special significance: the central nervous system and bone.

Abnormal neurological findings in compressed air workers have been described by Katschke (1967) in as many as 48 per cent. of the eight to nine hundred workers whom he has examined. In compressed air workers also, *carpal tunnel* of hands has long been accepted as a cause of symptoms occurring months or even years after decompression. More recently radiological examinations by the MRC Decompression Sickness Panel has revealed bone damage in nearly 30 per cent. of such workers, many of whom have had no episodes of acute decompression sickness (McCullum *et al.* 1966). Lesions around the knee joint are usually painless but usually are confined to the shafts. In hips and shoulders, however, such lesions may be followed by the loss collapse of joint articulation from the onset of joint pain and the need for surgical intervention.

The first cases of *carpal tunnel* to be reported in compressed air workers were those who presented with pain and it was not till some years later that radiological examinations of sample groups of apparently fit men were made in order to detect the pre-symptomatic lesion.

In a similar manner the first reports of *carpal tunnel*, as above, were those in which the patients had sought treatment for joint pain (Table 1). The appearances, sites of the joint osteolysis and shaft lesions are given in Fig. 1. Limitations in any conclusions drawn from such data are imposed partly by the relative severity of

TABLE 1  
Sites of Lesions from Individual Case Reports of Elliott

Author	No. of Cases	Metacarpal (Metacar)	Scaphoid (Scaph)	Scaphoid (Scaph)	Trapezoid (Trapez)
Guthrie (1947) (274)	1	R, L	—	—	—
Simon (1947) (1)	1	R, L	—	—	—
Dale (1952) (2)	2	R, L	—	—	—
Rowell (1954) (1)	1	R, L	R	R, L	R, L
Cooper & Coates (1954) (1)	1	—	—	R, L	—
Freeman & Coates (1954) (1)	1	—	—	R	—
—	—	R	—	—	—
Simon (1958) (1)	1	R	—	—	—
—	—	—	—	—	—
—	—	R, L	L	L	—
—	—	R, L	—	—	—



Distribution of lesions  
from individual case reports of divers

Fig 2

the original diagnosis, as patients do differing radiological interpretations of the x-rays, size and extent of the lesions and also to the case reports themselves. For reasons in some papers it is not possible to distinguish between the shaft lesions and the potentially disabling peri-articular lesions.

Since the report by Grossmader (1961) there have been a number of surveys of selected samples of the diving population. Of 70 German divers assessed independently by Knappe (1962 & in 1963), 29 had major bone lesions. Of the 13 Swedish divers examined by Nordahl (1959), three were found to have bone lesions. An extensive survey was conducted in Germany by Altner (1963) who listed 32 cases of bone lesions in 134 divers (Fig 1). Of these men, 68 had been kept under observation for more than ten years, only 22 of them showing that all radiological lesions of the 63 with lesions, 17 had symptoms and 7 were totally unable to work. In 29 divers examined by Korytko (1964), 19 had radiological lesions.



The distribution of lesions in 12 divers  
(after Albee, Hengel & Seasing, 1964)

Fig. 2



The distribution of lesions in 152 divers  
(after Ohio, 1969)

Fig. 3

Formerly, Jansen and Ljander (1963) found lesions in 133 men, 74 (55%) with war wounds, and considered there to be an incidence of more than 24 per cent of British doves in Japan (53 cases of bone marrow was found by Chou (1964) in 304 gas incriminated doves (Fig. 7). An incidence of 18 per cent was found in doves aged 35 to 39 and 16 per cent in those over 40 years old.

Thus, in these surveys (Table II) of which there would seem to have isolated any war before doves, there was an approximately 50 per cent incidence of shaft and joint or shaft lesions with lesions in the head of the humerus and in the head of the femur in the approximate value 2:1.

TABLE II  
The Distribution of Lesions in Previous Surveys of Doves

	Doves Examined	Doves with Lesions	% Lesions	Number of Doves with Lesions		
				Head of Humerus	Head of Femur	Shaftles (or Other)
Warrior (1944, 1945)	47 all prisoners after 1944 census	15 26	36 55	13 —	4 —	— —
Significant (1948)	15	5	33	3	2	—
Warrior (1958)	80 for 10 years 15 total	43 72	— 53	35 —	11 —	7-1 —
Kaplan (1960)	25	18	72	17	1	—
Chou (1964)	304	152	50	12	19	21
TOTAL	161	123	76	—	—	—

Although previous pilot studies of naval war veteran doves had revealed no case of bone marrow it was considered important to initiate a radiological survey to cover a large proportion of our professional doves. This annual survey is still continuing and much remains to be done. Although the full results will not be available for some years, the preliminary findings are of some interest.

The objective was to survey as many as possible of the professional doves serving on the Royal Navy in order to discover the incidence of any of radiological lesions. It was thought that an annual X ray for three consecutive years might be sufficient to define the extent of the problem. Although in fact it has been possible to X-ray only a proportion of the total number of doves, the results so far obtained are sufficient to justify making this radiological examination a regular part of the annual medical examination.

The radiological technique used in particular the measurement and classification of any lesions found are described in Part II.

There are many causes of lesions, being exposed in addition to previous decompression from raised environmental pressure. Among the candidates, which need to be included in each patient are white cell anaemia, osteoporosis, polyarteritis nodosa,



12 plots, long-term environmental therapy and disease algorithms. It may, perhaps, only alcoholism would seem to be relevant to an active diving population. In this small sample no new air lesions were found by the MRC. Found in more than 100 new workers not previously exposed to mixed environmental pressures (McLennan and Widdar 1984) and further unpublished data. A radiological comparison of 100 naval divers and ratings is planned in order to establish a baseline incidence of similar lesions in a comparable but non-diving population.



Distribution of lesions in 14 naval divers

Fig. 1

Of the 150 divers 81 aged by July 1989. 16 radiological spots found to have been assessed of whom two have associated symptoms. This gives a less than a 2 per cent incidence of radiological lesions in serving naval divers.

The management of the diver with lesions is still under review, but a radiological diagnosis of Dumbbell or Positive vacuum positive lesions. The individual is to remain flat during to within the limiting time of the Royal Navy tables. This allows a maximum for instance of 20 minutes at 150 ft. The hazardous decompression of experimental and only human diving are no longer permitted.

If there is a particular lesion and particularly if there are any symptoms associated with an affected ear, then it is necessary to reconsider the whole future diving career of that individual. Until the clinical condition has been assessed by an otolaryngologist specialist such individuals are not permitted to dive. The one exception, allowed is that diving to 25 ft. with closed circuit oxygen apparatus is allowed, a technique which allows the diver to perform some useful work, and which is less likely to be without decompression hazard.

In comparison with the other surveys, a study of the distribution of the lesions found in the Royal Naval divers shows (Table III) a proportionately greater number

TABLE III (a)  
The Distribution of Lesions in the Survey of 200 Naval Divers compared with other Surveys

	Gross Incidence	Divers with Lesions	Dumbbell	Number of Divers with Lesions listed in parentheses: Number of Lesions		
				Area of Dumbbell	Area of Positive	Frequency (by Table)
Adair (1940)	134	72	20	— (140)	— (140)	— (140)
Orlin (1945)	201	182	70	51 (134)	51 (134)	11 (140)
Royal Navy	150	14	4	4 (10)	4 (80)	11 (135)

of lesions outside the clinically significant sites on the basis of the lesions and the lesion. This is probably only a reflection of the more extensive radiological search in this survey. However, it would be naive to suggest that the incidence of lesions in civilian divers using the radiological criteria now to be described is any much greater than that in naval personnel. Although this may seem reasonable, it is important to remember that it has now been previously established that diving surveys of boats involved an occupational hazard of naval divers (Fig. 2).

## II—The Radiological Features

The early radiological changes of organic bone lesions are difficult to detect and require an educated eye and good radiographic technique. The earliest signs of the accepted lesions were vacuum defects and for the reasons it was classified under some lesions that remain doubtful.

The parameters we have used in our survey are those agreed with the MRC Decompression Section Panel. The lesions may be broadly subdivided into *A*, parietal and *B*, hard, soft, and shaft lesions (Table IV).

In general the parietal area lesions give rise to symptoms occasionally or not at all. The category *B* lesions are usually symptomatic and so serious.



Fig. 1. Anteroposterior radiograph of a knee joint showing a large suprapatellar cyst.

TABLE I

## Radiological Parameters of Anaplastic Ewing Sarcoma

- |                   |   |
|-------------------|---|
| A. Antra antralis |   |
| AS                | Perforation of the antra, a antralis cavity |
| AS                | Subantral septal expansion                  |
| AS                | Lateral expansion                           |
| AS                | Suprapatellar extension                     |
|                   | 121 Translucent subantral band              |
|                   | 122 Opacities of suprapatellar cysts        |
|                   | 123 Displacement of cysts                   |
| AS                | Secondary displacement of the tibia         |
| B. Tibial         |   |
| TS                | Top A and B (tibial) lesions                |
| TS                | Perforation of the tibia, a tibia antralis  |
| TS                | Longitudinal septal expansion               |
| TS                | Transverse septal expansion                 |
| TS                | Distal displacement                         |

*Embryological Lesions of Aqpaq Bone Neurons*

These lesions have been described (Goldberg, 1967; Davidson, 1968) and I am now illustrating in an *Atlas of Radiological Changes* (in *Current's denture problems*) by the MRC, Developmental Stochastic Registry from X-ray films of animal skulls (Davidson, 1968).

*Developmental Lesions*

1) *Denar areas* (with contact with other areas) (Figs. 6 and 7).

These denar areas, which have been observed (Ries and Riesen, 1964) have an irregular margin. Any trabeculae passing through the areas appear to be isolated.

The denar areas are surrounded by apparently normal bone and occur close to and often touching the articular surface. The lesions occur more commonly in the head of the humerus than the head of the femur. The lesions are often bilateral and are deep.



Fig. 6. X-ray of the humerus of a rat's humerus.



Fig. 7. Case No. 11. Stage 40 *Polychaeta*.

#### *a2. Spherical Segmental Openings*

Cruciform shaped openings occur at the head of the lemniscus and less frequently on the trunk. The lemniscus was first described in 1956 as a 'chain cap' lesion (Poppel and Robinson, 1956) but their description was, somewhat, from the present accepted lemnisc.

#### *a3. Linear Density*

The lemnisc also occurs more commonly at the buccal head and is usually unilateral. The density is usually more linear and extends from cornea to cornea—the area enclosed between the linear density and the vitreal cortex may appear vacuolated but small multiple dense areas may be on the skull side of the density. The dense areas occur in the approximate position of the old epiphyseal line and may be differentiated from it.

#### 44. Structure features

Although debated vigorously it is uncertain whether the lesion necessarily passes through all these stages though the stages of these lesions are most 'obviously' featured in our series by Case 127 in which we were fortunate to obtain serial films which provided the survey films (Figs 8, 9 and 10).

#### 44a. 'Typical' osteocytic dead'

This lesion occurs in the humeral end, scapular heads. The lesion is sub-articular and narrow and follows closely the joint articular surface. It presumably represents a sub-articular fracture line (Newman and Boleough 1963).

#### 44b. Collapse of articular surface

Part of the articular surface on the humeral or scapular head with clear and sharp edges, located (a) superiorly and medial (from 0° rotation) (Fig. 8).



Fig. 8. Case 127 (Femoral head of 55-year-old female) on 20° hyperextension, 1960.



Figure 2. (a) Normal eye. (b) Detached retina. (c) Detached retina. (d) Detached retina. (e) Detached retina.

#### 4.4. Deep anterior uveitis

In the lesser part of the vitreous cortex separates in fragments but the fragment remains flexible and does not become depressed within the lens or humeral head. The detached fragment may be small but more usually a considerable segment of the total is involved. There may be associated marked dactylitis, at the adjacent base to the detached fragment.

#### 4.5. Other entities

Any post-traumatic lesion of cornea, lens or vitreous may lead to some corneal changes when the lesion is longstanding. Whatever form is taken by these secondary degenerative entities changes the post-optic in both the physical and the aesthetic value perceived and narrowing only covers the clinical stage.

#### 5. Macul, Nod and Shift lesions

These lesions are vitreous, from the cornea and vitreous cortex and are believed to cause myopia—though in our series are always associated with a double



Fig. 16. (Cont.) to 177. (a) on left lower.

lesions, possibly their detection. The lesions may occur anywhere on h, associated with pale, nodular lesions.

**B1. Bone cancer (Figs 11 and 17, Case No. 112)**

There are not bone islands and occur commonly in the neck and distal of the humerus and the shaft of the femur. The lesions are usually multiple, and bilateral but may only become so. The lesions are usually small and ill defined and difficult to detect with certainty until they have been observed usually in bone, then read as density and system and have become multiple.

**B1. Dorsal colored areas**

Initially unilateral but frequently bilateral these lesions occur commonly on the dorsal shaft of the femur, the proximal shaft of the ribs and less commonly on the proximal shaft of the humerus. The lesions occur within the medulla and are of varied





1000 1000 1000 1000 1000 1000 1000 1000 1000 1000

conclusion and discussion. They may be used to show an increase in the number of successful cases. The student leaves an extra row, not used on the first time, and at the same time may account for their early decision on the first time. It is better to leave an extra row only at the last time we take the exam (1999, 14, 15, 16 and 17).

doi:10.1017/S0007122612000096

There are ill-defined and vague in the head and neck of the hamster and neck of the hamster. The hamsters have a relatively small and distinct skull.

## 2.1. Generalized $\alpha$ -Law

Unconscious and difficult to detect when solitary. In its earliest stage it is difficult to distinguish from normal developmental variation.



Fig. 1.—View to 135° L. in AP projection.

#### Radiographic Technique and Projections

These films are our parameters and the basis for which we have searched. To obtain the best view requires good radiographic technique and films of good quality and high bone detail. In the Navy we have stressed the taking of three X rays on an angled beam for all clearance views in specific establishments. Our technique is then agreed with the MRC Decompression Section, Fleet and now being adopted as an international base. The views taken are a compromise between a complete examination and reduction. With good technique the examination can be repeated on an angled beam without excessive radiation.

The radiographic examinations (Table V) are specific but not excessively detailed.

For reasons of limiting radiation exposure our examination is limited to both shoulders, both hips and both knees and only at the knees do we take lateral films. The main difficulty is not in positioning except in the femur and humerus where the difficulty lies in flexing the limb of these bones from the joint area, but in obtaining





Fig. 14—Knee, T-15, 2700000, 2700000, 2700000

radiographic projections (Table VI) for the survey though in specific cases we have taken further films but we have seldom employed tomography in order to limit radiation exposure.

#### **Radiological Interpretation**

The emphasis to be placed on minor variations of the trabecular structure of bones X-rayed must remain subjective and depend on the skill and experience of the radiologist. Decide may remain on initial X-ray read with a radiologist familiar with these early lesions. The films in our survey are read initially by the Service radiologist in the department in which the chest X-rayed. The films and their reports are forwarded to Herts where they are read and compared with any previous films of the dove (1 & 2 11). Selected positive films have been reviewed (Campbell-Golding, Davidson, MRC, Deconspensius, Jackson, Pajali). To date approx 200 doves have been X-rayed and 14 classified as positive with some 15 doubtful lesions. As this stage many films



FIGURE 1. Lateral view of knee joint.

TABLE VI

Radiographic Projections for Knee\* (See Series 1 film)

## 1. Standing

AP radiographs of each head of femur and proximal shaft. The knee is extended to bring the distal end of femur in contact with the table with the axis pulled down and in a neutral position. Knees are shown in weight of the foot/leg shafts as possible (keeping the lateral radiograph in to show only the head and shaft of the femur).

## 2. Flex

AP radiographs of each femoral head and proximal shaft of femur.

Center just the head of the femur for 1 cm below the midpoint of a line passing the anterior superior iliac spine and the upper border of the pubic symphysis. Distal with light beam, radiograph to give a view of distal shaft. This knee should be in full flexion as a stable knee.

## 3. Supine

AP and lateral radiographs of each knee including as much as possible of the distal femur and proximal tibia on a 15 x 10 film.



Fig. 19. The hand of patient 17 (see text).

are 'under' rather than 'over' used. On completion of the 3-year survey (1994, December 1995) it is proposed to double read the film. (Completed Coding: and P.A.B.H.) will originally examine any film in which interpretation differs.

In addition to the accepted parameters of trapezoid bone nerves described an effort is made to record some abnormalities of bone structure not as present accepted as evidence of being nerves and in addition to the detailed report the results are classified and coded under the present parameters against the case number. An extract of these coded results of the 14 percent patients (2003) is shown (Table VII).

It will be noticed that some of the bones have been reduplicated since an earlier preliminary communication (Elliot and Flaxman 1989).

On completion of the survey it is proposed to X-ray a sample of 100 most prominent in similar groupings not reported to pressure changes.

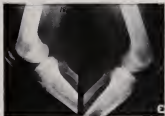


Fig. 1. Footing (left shoe) during one walking trial.

### SUMMARY

We have identified that impact foot motion occurs in a very distinct, but previously unreported, direction.

As a result, the survey X-rays have been incorporated in the way in which a medical medical examination.

We have removed and are measuring small areas of skin, which are examined in detail and compared to detect any changes in the radiological appearance of these bones which occur with continued exposure. From these records we hope to obtain new information on the various radiological appearance of impact, bone disease.

As a by-product of the survey we have undertaken measurement of high altitude exposure and exposure employed in submarine escape training.

In addition to the detailed radiological records we have received considerable information of drivers, symptoms and experience. Much remains to be done in the statistical analysis of these records of driving and their correlation with the radiological findings. However, even while the survey proceeds we have at least already improved our use of a systematic and systematic section of radiological personnel.

Final evaluation of the statistical methods and distribution of these bones in the road drivers were accordingly direct completion of the survey on the 31st December 1968, and the subsequent double re-examination of the X-ray films.

TABLE VII

Case	Response		Heart of Premor		Heart Premor		Upper limb		Poststroke	
	R	L	R	L	R	L	R	L	R	L
121	BC	BC	—	—	—	—	—	—	—	—
22	—	—	—	—	+	BC	—	—	—	—
34	—	—	—	—	BC	BC	—	—	—	—
49	—	—	—	—	BC	BC	—	—	—	—
133	—	—	—	—	—	—	—	—	BC <sup>1</sup>	—
5	—	—	—	—	BC	BC	+	BC	—	—
155	—	—	—	—	+	BC	—	—	—	—
81	+	+	—	—	BC	BC	—	—	—	—
159	+	—	—	—	+	BC <sup>1</sup>	—	—	—	—
159	—	—	—	—	BC	BC	BC	BC <sup>1</sup>	—	—
127	—	Ad	—	—	—	+	—	—	—	—
111	—	—	—	—	BC	BC <sup>1</sup>	—	—	—	—
155	—	—	—	—	Ad	Ad	BC	BC	—	—
155	—	—	—	—	—	BC	—	—	—	—
91	Ad	—	—	—	—	—	—	—	—	—

<sup>1</sup>Stroke

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## PROBLEMS OF COMMUNICATION AND EAR PROTECTION IN THE ROYAL MARINES

By M. E. Forrest and R. E. A. Cole

### SUMMARY

A single modification to the V 800-type plug has enabled ease of communication to be combined with adequate protection against high-intensity noise, notably of gunfire origin. These modifications were developed and tested in the laboratory by means of hard-milled artificial ears, real-ear ear, pressure and speech transmission threshold tests. Their performance was proved by means of series of 115-subj. and communication trials. It is believed that these earplugs, the silence region, anticipated earplugs for usage in all gunfire noise exposure situations in which the latter are available and.

The auditory hazards of noise and the means of protection against noise-induced hearing loss have become widely recognized in recent years, particularly within the Royal Navy and Royal Marines (Cole and Knight, 1961). There is little unusual regarding former aspects of noise and its effects except the grosser preponderance of high-frequency impulsive noise, as from weapons firing, for which there are now means of noise measurement and hazard evaluation (Cole, Gamble, Hodge and Rose, 1961).

On the other hand, there are differences in respect of the degree of disciplinary control of usage of ear protection that can be exerted and of the greater need for preservation of acute hearing as a by-product of communication personnel activities.

In the case of the Royal Marines, one of ear protection is the role of the soldier rather than the commander. This occurs in all situations except in actual combat and occasionally in field firing ranges at high levels. On classification ranges, with their fixed firing points and in open well spaced areas in a line or right angles to the line of fire, there is only a moderate degree of auditory hazard or of difficulty in communication between and among units.

The situation is quite different in field firing, an example of which is illustrated in Fig. 1. In the case, there is both additional auditory hazard as well as a much greater ground surface hazard, forward and rearward, need for reliable communications between commander and command, particularly at close fire, as firing positions move in the target area or when circumstances move close along the line of fire.

The additional auditory hazard derives from the fact that choice of firing points is dictated by the nature or timing of adequate cover, which often entails branching of men and close or vehicle distribution over the ground, as shown in Fig. 1. The noise of rifle or machine gun comes mainly from the muzzle and is greatest at angles of from 0° to 45° from the line of fire (see Fig. 1, Cole and Blair, 1961). The noise heard from a close-up neighbour's weapon is in fact greater than that of the fire's own



FIG. 1. Pasture weeds, as *Leptochloa setacea*, in pasture *Setaria viridis* (nearby station, Nanyang County, East Hubei, China).

was present if it is an early time of year. But in an earlier distribution of birds, most of their positions were tall. Consequently, there is much greater need for ear protection in field long research.

Up to now, no accident has been attributed to failure of communication due to wearing of earplugs. But the anxiety over communication efficiency in ships and sometimes communication difficulties caused by earplugs, reduce the use and effectiveness of advanced hearing devices. Meanwhile enough. These factors affect the general attitude towards ear protection. Consequently, research effort has been devoted usually a solution of this problem. An ear protector was needed that caused less impairment of communication but gave adequate protection.

The first study of Subsonic earplugs, has already been reported in the journal (Coley and Rice, 1985) but this earplug did not provide a sufficient improvement for it to be adopted for Soviet usage.

A little later, the telephone Research and Development Establishment at Waltham Abbey, Essex, developed a communication headset called the ERAD headset (Fig. 2). On each side of the headset there is an earmuff with an external microphone, a peak hearing amplifier set at 10 dB over gain and an internal telephone receiver. Signals under 85 dB are heard with remarkable clarity, while over 85 dB the peak hearing properties of the amplifiers come into play and the sound seems to emanate by the basic earmuff component of the headset. While having considerable potential applications within the service, once certain standard weaknesses have been cor-



Fig. 2. The (R.A.F.) radio communication helmet (designed by members of Royal Air Force Research) during 1936.

1936, the *headset microphone* (Fig. 1) and *earpiece* (ear contains ear in response to the V. A. microphone diaphragm) (Fig. 2).

The *Officer Model 21* (presently at the Institute of Naval Medicine under their design supervision) and will be called the *Gundelfinger* both for ease of description and because the name implies its principal potential usage. Though simple in design it is the product of extensive laboratory development and field testing, as will be described. Its essential features consists of a thin metal plate with a probe aperture in it, which replaces the body of the conventional V 518-4 type earplug (thence) that is used by all three services for ear protection. Figure 3 shows in cross section the original plug being then with its centre cut out, and finally with the perforated metal disc in position. The complete plug as it is during a standard ear experiment is shown in Fig. 4.

Low intensity sounds pass through the aperture easily with minimum flow characteristics, whilst with high intensity stimuli there is turbulent flow—the latter being related to increased attenuation. Thus the more intense the sound above about 110 dB SPL the greater the attenuation (see Fig. 6 later)—a property we have termed *impedance sensitivity*.

The performance of Gundelfinger type of earplug was checked first by means of hard boiled artificial ears which checked its impedance sensitive properties both for position and for response. But, because these earplugs gave attenuation results for lower earplugs that clearly were very much too great, a more natural soft-boiled ear was sought. The best possible such artificial ear was in fact that of both cadavers and studies of Gundelfingers and other earplugs and naturally were carried out with a series of series of them.

In this technique, a Royal and Kuper J with microphone was introduced through a



Fig. 3. Development of eye on larva 1. 1 - eye; 2 - eye; 3 - eye. The eye is shown in the middle of the larva.



Fig. 4. The complete larva (larva 1) on the 1st day of development. The eye is shown in the middle of the larva.



Fig. 1. Diagram of cadaver in prone position for coupling studies (shown by courtesy of Institute of Dental and Otolaryngological Research, University of Stockholm).

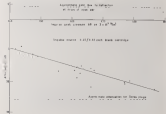


Fig. 2. Graph showing the relationship of coupling studies by Otoscopy (shown by courtesy of Institute of Dental and Otolaryngological Research, University of Stockholm).

applied down from within the shell through the eardrum wall of the deeper bony part of the external auditory meatus, so that the sensitive surface of the microphone rested just lateral to the ear drum (Fig. 2). Another microphone was placed externally just in front of the meatus for the purpose of monitoring the external sound. The difference in the axial position between the two microphones with and without ear defenders in place allowed precise, repetition and reproducible measurement of their attenuation characteristics.

The attenuation for impulse by the Condaminder and the Saxon earplugs was then shown to increase in the manner shown in Fig. 4, which accorded well with theory and data derived from the hard-wired artificial ear measurements. Most important at the highest level of impulse noise in which Saxon earplugs are likely to be used, or about 145 dB, the Condaminder appeared to give virtually the same degree of protection.

The pure tone attenuation properties of the Condaminder at low sound intensities were measured also by free-field threshold shift studies at a small number (8-14) of normal hearing subjects. These results, together with those derived from artificial ear and artificial ear, are shown in Table 1.

TABLE 1  
Pure-tone correction data for Condaminder earplugs

	Mean attenuation (dB) at test frequency (Hz)								Speech attenuation (dB)	
	125	250	500	1000	2000	3000	4000	5000	Condaminder	Mean measured on 8 subjects
Real ear (N=4)	—	-1.1	3.8	8.7	7.9	17.7	11.7	12.4	9.9	3.2
Artificial ear (N=7)	2.5	-4.4	-3.4	3.6	25.6	18.2	14.9	14.5	7.6	—
Artificial ear	8	-1.0	-2.3	-2.8	12.8	27.5	19.0	—	0	—

As can be seen, the agreement between methods is good, except at 2000 Hz at which frequency there appear to be major over-estimates in the external auditory meatus in the real-ear measurements in particular.

The table also gives the calculated speech attenuation based on the formula proposed by Cole and Rice (1965) for calculation of speech attenuation from pure tone data together with free-ear speech attenuation results in another small sample (N=5). These 3.5 dB speech attenuation figures obtained in the laboratory, thus the Condaminder was likely to be a substantial improvement with regard to speech communication, as compared with 10 dB by the Saxon earplug and 15 dB by the Silhouette-K earplug as previously reported by Cole and Rice (1965).

Thus in the laboratory the Condaminder appeared to meet its design requirements most satisfactorily in respect of both good attenuation of high intensity sounds and

high intensities of low frequency signals. For such unconventional signals, however, these properties had to be proved by extensive field tests.

These effectiveness against noise was shown by means of virtual studies involving reduction of positive noise-induced temporary thresholds (TTS). The experiments of this sort that were carried out are tabulated in Table II. In each case, the Gendefenders either gave complete protection of TTS or left sufficiently high TTS for it to be regarded as negligible or given no greater TTS than found with Sonar signals. It was concluded that Gendefenders were safe as a potential replacement for Sonar signals, for every impulse noise-random stimulus for which Sonar signals would be used, which is up to about 185 dB peak pressure level ( $\approx 2.00027 \text{ bar}$ ) in the case of the Carl Gustaf automatic weapon.

TABLE II  
TTS tests with Gendefender signals

No. of subjects	Peak pressure dB	Duration of stimuli	Ear protection conditions tested			Number of subjects
			Gendefender	Sonar	Ref.	
Left hearing (n = 10)	180	5 sec 120	—	—	—	12
Left hearing reduced due to TTS of stimulus	175	5 sec 120	—	—	—	12
Right ear normal	as TTS 180	as 120	—	—	—	12
Left ear 5, 1, 1, 1, 1 2 to 1 sec. gain	TTS 180	15	—	1.12 <sup>a</sup>	—	4 <sup>b</sup>

<sup>a</sup> In a study subject adequately with Sonar signals the protection of noise was more or less as that of the Gendefenders.

<sup>b</sup> 12 = 185 dBS of lowest high susceptibility to noise-induced TTS.

Current events took root from formal experiments with groups of humans in various situations from a weapons training exercise showing proposed sequences of target-control orders to subjective measurements of state of consciousness on field firing and observation ranges. The trials cannot now be listed in Table III.

In the tactical order experiments, showed the Gendefenders to have marginal advantages over Sonar plugs, but it was an practical output that the real merit of the plugs became overwhelmingly apparent. No longer was it a strain to listen and no longer that orders might be missed with Gendefenders the men said they would not have the same doubts of using signals that they had with Sonar plugs. Perhaps the most elegant praise for the Gendefenders was rendered by the present reluctance of the men to part with the real (Gendefender) signals.





# ACCUMULATION OF STRONTIUM 90 IN HUMAN TEETH AS A RESULT OF NUCLEAR FALL-OUT

By Neil Sharley

## ABSTRACT

Strontium 90 resulting from nuclear fallout, is taken up by bone and teeth during growth of calcification. The results are reported of a dental survey carried out by the Royal Navy since 1959. There is a time lag of three to four years between the development of the roots and the development of the crown in relation to the total period of calcification which allows the possible rate of uptake to be determined from tooth counts. Since there is close correlation between tooth and bone levels, tooth counts may be used to monitor bone levels in living subjects.

The uptake of strontium 90 in the mineralising tissues is related to the level of contamination in the atmosphere. Fall out was insignificant before 1955 but in the next 11 years the world wide deposition of Sr 90 increased over a hundredfold—from 0.1 megacuries in 1953 to 12.53 in 1965 (Fig 1). It is interesting to note that in



Fig 1

year of the test has been observed by Rasmussen, Anderson and Christ-Jensen, 1967 with the first year in which the rate of radiocesium decay exceeded the rate of deposition.

The ratcage has a radiocesium half-life of about 25 years, so in terms of the human life-span it is permanently radiocesium. Its chemical properties are analogous to those of calcium. Both substances are absorbed into the body and they accompany each other as part of the food chain. Inside the body they metabolize in the same way, follow the same physiological pathways and both of them pass into the bone state of teeth and bone at times when calcification is taking place. The rate of uptake depends on levels prevailing in the bloodstream and therefore, at any one time they are laid down in exactly the same proportions (relative to each other) in teeth and bone.

How long they stay there is a different matter altogether. Bone is, of course, not the teeth and another. The bones are in a state of constant mineral exchange and even heavy 90 is constantly being returned into the plasma during the normal course of mineral turnover and occasionally more if a gain is needed. On the other hand, in the case of dental tissues, the bone cells are incorporated by irreversible deposition. They become polished from the bloodstream and there is no way for them to come out again (except for minute traces at outer exchanges). So in effect, the 90 has a longer biological half-life in the teeth than it has in bone. It follows that radiocesium levels in bone do not necessarily apply to the teeth and in 1959 the Royal Navy set up an independent dental survey to run parallel with the hand survey that had been started by Medical Research Council the previous year. One of the objects of this paper is to give a brief summary of the results.

The investigation is restricted to perfect teeth. They must be white and sound—otherwise the analytical results would be inaccurate. Therefore, premolars from persons 9 to 15 years old and third molars from persons 17 to 25 are used. These are fairly plentiful due to being routinely extracted to replace overcrowding or separation. Up to the present, over 11 000 specimens have been collected by 70 persons (dentists) situated all over the country. The roots and crowns are divided, polished according to age group and analysed separately. Stable strontium is determined by flame photometry, and uranium-90 by radio-chemical methods modified for teeth as described by Bryant, Henderson and Holgate (1963). Corrections are made for radiocesium decay and the results expressed as percentages of 50 90 per gram of calcium. Examination was carried out twice a year so that they provide a continuous set of statistical tables (Sharkey, Bryant and Henderson 1964; Sharkey, Goodridge, Fletcher and Weeks 1965). For the present purpose it will be sufficient to take the mean annual values and only consider the premolars.

Figure 3 shows annual whole teeth values arranged according to age groups and they are amazingly consistent. Reading from left to right—the spread of a constant 90 increases year by year—and, as age (thereafter) falls it is inversely related to the age of the children (holding each column from top to bottom). That is to say, the later the teeth were in situ, the more they were affected by the increasing nuclear yield. In the older groups (towards the bottom left hand corner) a considerable bulk of teeth had been formed before the atmosphere became seriously polluted in oil—and the mineral burden is low, especially in the crowns. As time goes on, according

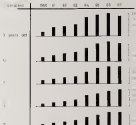


Fig. 3. Percentage of total growth values for 1960, 1961, 1962, 1963, 1964.

in preserving nuclear yields, different parts of the tooth will become more or less affected, but for the present the isotopic gradient is low in the crown (182 ppm) along the length of the tooth towards the apex.

This becomes clear in Fig. 5 where deceders, roots, and crowns are shown, separately. Although both root and crown reflect isotopes with the passage of time—the roots are always high compared with corresponding crowns. In point of fact, since they are the true genesis of the tooth in form, the roots reflect contemporary conditions (most costly price in a situation, while the crowns reflect the earlier levels that existed when they were maturing themselves. In short they are a flesh book to the hair shirt.

This provides a veritable model for working out the probable rate of uptake in the tooth and therefore in time before the official surveys were even started. On average, there seems to be a time lag of three or four years between the development of the roots and the development of the crown in relation to the total period of maturation. Taking any age-group on the chart, we find that crowns extracted in 1964 compare fairly closely with roots extracted in 1960. They were both calcifying in 1960 (allowing for an age difference of 4 years) and presumably they were equally affected by the prevailing dietary conditions. Thus, it is possible to extrapolate. If crowns extracted in 1964 show the uptake of strontium-90 in 1960, crowns extracted in 1963 should give the uptake in 1959, 1962 should equal 1958 and so on back to 1946 which is approaching the zero baseline. In other words, they are living fossils.

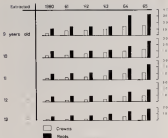


Fig. 1. *Percentage nettes and grosses by age 1960-1965*

The model has been expanded along these lines in Fig. 8. The crown's class has been tooth-classed and arranged in sequence so as to provide the route to which they belong. The net-nettes on the left relate to the crown, and those on the right, to the root. Fused together they indicate the probable rate of uptake in the edifying tissue since 1956—marked on the time scale along the horizon. The dotted line refers to bone. It is derived from the assumed average for diseased persons aged 3-10 years old (SIRIC assessment reports, 1960-67) and it is interesting to notice how closely the tooth and bone results agree. This supports the earlier concept that the ratio of Sr/Ca laid down in the calcifying tissues is the same in the tooth as it is in bone being laid down at the same time.

This being so it suggests a way of obtaining tooth images in existing bone levels in subjects who are well-dent. More than this it means that at any future date it should be possible to estimate previous bone levels from the levels prevailing in the tooth—assuming of how the fall-out may have fluctuated in the meantime. This could be very important in the event of a nuclear war.

For the moment, there is no evidence that existing levels present any immediate danger. In our own experience it has been necessary to give considerably higher doses, before rejection effects were produced experimentally, consisting in the order of a

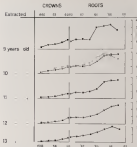


Fig. 4. Crown and root values (dpm/gm)  $^{90}\text{Sr}$  averaged chronologically.

involved thousands times, the amount of protein available via the diet. On the other hand, the natural life-span of these small animals is brief compared with human expectations and at this stage very little is known about the effect in man of small doses received over very long periods, and still less about the effect of large doses.

It would be unrealistic, when inspecting capsules of poisoning the whole planet, not to anticipate the danger that some of these could ever be used. If they were, greater levels of contamination could be achieved by tens of thousands within a few days of even restricted atomic warfare. The battle-front might be remote from centers of population and the areas of devastation strictly delimited, but a world-wide public health emergency would result—affecting continents and non-continents alike.

At this point the problem of measuring strontium-90 in the unextracted human tooth seems to be academic and becomes clinical. There are in fact two separate problems because of its different behavior in tooth and bone. If after a period of time, after optimal levels started to fall again, bone values would tend to indicate that that strontium-90 in the tooth would be retained at its original level. It would not be uniform throughout the community: it would vary in different age groups, and in different

each of the seven age groups according to whether or not they were growing when the fall-out was at its peak.

The interpretation of these factors belongs to the field of dental science. But as we have seen, the work can supply interesting information regarding levels of mineral reduction which previously affected the whole body. Such correlations could be of wide personal impact during the alignment, and they are the reason for including this particular aspect of dental research in the general biological section of the symposium.

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## PREVENTIVE MEDICINE IN THE NUCLEAR SUBMARINE PROGRAMME

By B. J. W. Lambert

### SUMMARY

Some of the new tasks imposed on the medical branch by the advent of the nuclear submarine are described. One aspect of the environment becomes a major part of the medical officer's duties and, in particular, atmospheric toxicology requires a sophisticated approach. A submarine constitutes both a useful model for certain lines of research, and some of these are indicated.

### INTRODUCTION

During the past decade the medical branch has had to assume a variety of new tasks with the emergence of the nuclear submarine. While one of these involves radiation safety it is not generally recognized that this is but a single aspect of the submarine doctor's job. The submarine presents an environment that gave birth to the nuclear submarine also imposed upon submarine medicine a number of functions not necessarily familiar to all medical men. The purpose of this paper is to show that these continue to form a fairly comprehensive picture of community medicine applied to a special care group.

The submarines involved are of two types. The Polaris submarines of 1 500 tons carry 180 men, while the smaller Fleet submarines of about 4 000 tons are complete medical facilities for 100 Polaris submarines, of which this country has four, probably the most expensive ships ever built for the Royal Navy, are run up as alternating two crew boats, each crew carrying its own medical officer. Fleet submarines carry a doctor usually, then only intermittently the special patrols throughout a commission. A team of three medical ratings is carried on every ship.

### THE TASK

To maintain the submarine standard in such submarines is perhaps even more vital than in comparable surface ships. The Polaris submarine follows a fixed cycle of two months on patrol and a month's maintenance. While at sea the submarine crew remain closed without resupplying and must maintain complete silence. To find in either of these would give away her position and sink is the fate for her existence. This means that once at sea, the medical officer is on his own much as he was on the ship of yesterday. He cannot escape to shore or, let alone transfer, a difficult task, while any major epidemic on board might well abort the patrol. To promote and maintain a healthy community under these conditions involves the processes familiar to occupational medicine of



- (d) Selection
- (e) Storing and storage of the data
- (f) Investigation and analysis of their environment
- (g) Follow up

The first and the last of these are mutually support tasks which, while they themselves necessarily fall mainly upon the supporting doctor

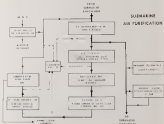


(Fig. 1)

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The two most obvious environmental problems brought about by the change from food to synthetic fuels are the control of radiances and content of the atmosphere. The radiances of course bring in the area to the physicians and the engineers, and to the doctors. That is to say that radiances include are perceived mainly by health or safety in design, shielding and containment, while quite sophisticated machinery purifies and recycles the so-called the ship, but it falls to the medical branch to monitor the intensity day to day health physics, radiological and environmental control. A tremendous volume of information now runs on radiological control and the procedures used in radiances are well proven by continuously low dose rates. The evaluation of low control systems is summarized in Table II.

Why the production of an artificial atmosphere produces problems is perhaps not obvious. In the past, environmental scientists have not seen into major problems in the production because they have been unable to envision submerged for very long. Their underwater existence has always been limited by their history, especially tied in order to exchange between. They have been limited to either surface or water. With nuclear fuel propulsion depends upon an accurate prediction of power and the possibility of very prolonged submergence itself. With the Polaris program, this possibility has become an essential. In essence, the original system of air must be completely recoded and the numerous consequences of the conditions



factor of confined space entry. A dangerous specification of the system is shown in Fig. 2. Relatively sophisticated means are available to deal with oxygen and  $\text{CO}_2$ , but it is less obvious that methods are required to eliminate or limit an almost infinite spectrum of toxic hydrocarbons as well as other contaminants. These will be produced in practically any closed space, but under normal circumstances a space would not remain closed long enough for contaminants to build up to dangerous levels.

Contaminants are produced by a variety of materials in the shop, by a fire started by someone carried out by the door, and of course some, like the musketeer gas, are of purely human origin. Over 100 hydrocarbon groups alone have now been identified (Strandberg and Skiffeld, 1955). A few of the contaminants most commonly encountered are shown in Table I.

TABLE I  
REPRESENTATIVE SOURCES OF CONTAMINANTS IN SUBMARINE  
ATMOSPHERES

<i>Product</i>	<i>Source</i>
Aerobics	Frying
Aerosols, various	Smoking, lubricating oil, welding
Anaesthetic gases	Fluorocarbon, perfluorocarbon sparking
Aldehydes	Electron irradiation
Aliphatic nitriles, hydrocarbons	Paints—solvents, cleaners, fuels
Aromatic nitro	Battery gassing
Carbon dioxide	Exhausting, welding, cooking
Carbon monoxide	Smoking
Chlorinated hydrocarbons	Solvents—can beas, insecticides, etc.
Fumes	Air conditioning plant, the engine, fans
Glycols	Water based paints
Hydrochloric acid and hydrofluoric acid	$\text{CO}$ burner from stove
Methylal	Slaving battery, etc.
Metal fumes	Welding, welding, burning
Methane	Oxygen decomposition
Methylol	Depleted air chemicals
Miscellany	Batteries, thermometers, fluorescent lights
Mineral gases	Exhaust exhaust
Ozone	Sparking
Phosphoric compounds	Lubricants and fuels
Sulphur compounds	Lubricants and fuels
Sulphur dioxide	Exhaust exhaust
Sulphuric acid	Battery acid

Continued depends upon

(a) determination of what is present

- (b) setting acceptable maximum levels for each component,
- (c) devising methods to eliminate them, or at least to limit their build-up.

In many cases, while industrial figures for a 60 hr week are available (by 'Ministry of Labour' 1966), most of the last few years' knowledge existed as to the results of long term continuous exposure and much work has been, and still has to be done to this end. In some cases, current levels are determined on the basis of threshold limit values as no knowledge presently. In other cases, where this would impose an impossibly low limit, the concept has to be one of allowing reversible cumulative changes, but preventing these becoming irreversible on an exposure time versus compensation basis.

There are not so few other considered now, particular to the submarine environment that further complicate this subject.

- (a) Firstly there can be additive or even synergistic effects between two or more toxic components.
- (b) Secondly there may be potentiation of various strain parts and vapours by otherwise inert agents.
- (c) Thirdly there is always the possibility of potentiation by given different factors such as the small reduction, background or altered conditions in the ship.
- (d) Lastly there are changes produced in the chemical components themselves by ships, machinery including air pollution, machinery not infrequently operating in a dampish medium for these ions, then its presence.

Such then, coupled with the other aspects of submarine hygiene, and the chemical work of our medical officer at sea, are the sort of things with which the submarine doctor must concern himself.

In summary, he is the ship's medical officer, the ship's health physician, epidemiologist and resident toxicologist, and must also do a number of other jobs, occasionally left to specialists on a shore 'parent' base.

#### SUMMARY

Much of the back up medical support that must be provided for him has already been supplied. The crew and a healthy group already subject to these adverse possibilities—being also the Navy—take the submarine service, and for most of them, the medical standards for submarine workers. From this point the aim has been to study the epidemiology of the group as a whole. Risk lay stratification has been plotted against such day as point in order that other factors that could influence this pattern may be superimposed upon it. An analysis of attendance over three patrols is summarized in Fig. 3. With the help of Professor David and his colleagues at Glasgow, highly elaborate microbiological screening has been carried out, both before and after patrol, on the crew of one Polaris submarine over the past 18 months (Giles *et al.* 1968). These results have been coupled with bacteriological air sampling in the boat at sea (Horne *et al.* 1967). Other follow up studies to monitor the effects of ambient submarine services include:

- (e) Examination of blood samples with carbon monoxide compared with surface levels on patrol (Lewden, 1968).

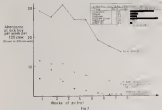
INCIDENCE OF LESIONS AND INJURIES  
IN 1260 SURVIVED SUBJECTS

Fig. 2

- (24) Studies on visual electroretinogram changes under prolonged exposure to low levels of  $\text{CO}_2$  in submarines (Kline *et al.* 1970).
- (25) Routine haematological studies in a closed room for various effects of the closed space syndrome.

## CONCLUSIONS

A considerable amount of work has now been done in the United States on the physiological effects of closed environments, in connection with both the submarines and the space programmes. In general a very reassuring picture emerges. However there are still questions to be answered, particularly with regard to possible long term morbidity which may too easily be overlooked. Indeed, the history of occupational medicine repeatedly demonstrates that without controlled long term systematic studies it is all too easy to overlook what at first sight appears to be an obvious causal relationship between morbidity and environment. Current interest in morbidities of the lung and circulations of the bladder are just two examples.

The task of the Subcommittee Medicine Section at the Institute of Naval Medicine involves two lines of approach. Firstly certain theoretical, basic research investigations and *in vivo* studies, if possible, a systematic assessment of risk. Secondly it is necessary to follow up any clinical or laboratory test that presents itself either from a study of screening procedures, selection criteria, or routine medical examinations. There are, of course, the general principles of epidemiology in occupational medicine.

and only after with an extensive search are we enabled to say that the ecology of the nuclear submarine is fully understood.

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## A POSSIBLE HAZARD FROM NUCLEAR SUBMARINE CORROSION PRODUCTS

By M. Hulsizer

### ABSTRACT

There is a lack of quantitative information on the fate of radioactive corrosion products from pressurized water reactors. An experiment with rats is reported which shows that there is virtually no absorption of corrosion product which from the gut fluorophotoline is excreted within days following an intragastric intake of corrosion products are discussed.

The crews of nuclear submarines live for long periods very close to their reactors. Facilities for input are limited at sea. For these reasons nuclear submarines are specifically designed to give out lower levels of ionizing radiation than their land-based counterparts.

Radiation hazards will exist, however, both during normal running and in man-down and refueling periods. There are two quite different hazards: radiation from a reactor referred to the crew, and radioactivity contamination, in which radioactive substances have been released or exposed. In the former, the radiation dose a man receives can be drastically reduced by increasing the distance between him and the reactor, or placing water doing shielding material between them. In the latter case, very little can be done to lessen the radiation dose to the crew. An amount of radioactivity inside the body is several orders of magnitude more effective in producing radiation damage than the same amount outside.

In a normal running submarine the extremely radioactive fuel is surrounded by a biological shield. The core are separated from it by the cooling water and two steel shields separated by a large air space. As a result, they receive a smaller radiation dose than the average hospital outpatients. They are exposed to no radioactive contamination in the core, and only very slight amounts in the cooling water when they sample it.

During maintenance and refueling, the fuel goes out a lower level of radiation, penetrating every inch of the air space. Here, a part of the radiation dose comes from corrosion products deposited on the inside of the water cooling pipework. These corrosion products are very insoluble compounds of the metal, and on the corrosion of the steel cladding and pipework, which have become radioactive in the normal life of a submarine from the marine rise. Once the pipework is repaired there is a risk that the corrosion products may be released or exposed.

The management of maintenance people is a topic on which the Naval Radio Isotopes Protection Service would be expected to give advice. The general principles of equipment decontamination after maintenance and exposure of radioactivity are well covered by Reports of the International Commission on Radiation Protection (ICRP) but

There remains some doubt about the long term fate of released insoluble radioactivity. The Medical Research Council (1964) and the Atomic Energy Authority are looking at the problem, but not in their reports positive to the nuclear submarine. The comparison of conversion products from waste-cooled submarines requires a difference from most other British reactors.

Ideally, studies of radioactivity could be performed by direct contact and supervision at some suitably supervised-enclosed work environment and under constant monitoring to show that no harmful gases in practice that is not possible. Since this will always be taken as most complicated cases and in the confined space of the reactor compartment, it is often person monitoring cannot but be worker. Neither is there a standard method of sampling the air in time or in details for particulate radioactivity. Instead, reliance is placed on instrumental monitoring with investigation after the event to check for contaminated people.

It is relatively easy to detect the presence of insoluble product radioactive contamination inside the body using nearly all such products emit characteristic gamma rays. Measuring the quantity of activity is not so easy, since the distribution within the body is not known. It is therefore necessary to collect urine and faeces, measure their radioactivity and estimate how much radioactivity entered the body and how long it is likely to stay. From this an estimate of radiation dose might be made.

There is an evidence either experimental or from accidents, to help make these estimates in man and very little is known. It was therefore decided that some experimental work be done at the Institute of Naval Medicine and whilst was chosen as an element of particular interest as that it is a component of radioactive corrosion products has a long radioactive half life (5.3 years) and characteristic gamma rays.



Flowchart illustrating the experimental work for the study of insoluble and soluble radioactivity

Fig. 1



which make it particularly easy to detect. Cobalt is a small element which, like, in the body is not well absorbed. It is possibly only absorbed in man as Vitamin B<sub>12</sub>, and as its excretion from it appears poorly absorbed from the gut. Such cobalt is absorbed is expected mainly in the small, with a proportion passing back via the gut to the liver. Figure 1 shows the main pathways.

Figure 2 shows the results of experiments on the normal rat in man.

	Soluble Cobalt	Complexed Cobalt (Cobalamin)
Proportion of oral dose excreted in urine in 10 days	3%	~100% <sup>1</sup>
Proportion of activity in the blood stream normal in 10 days	~1/10 <sup>2</sup>	~1/10 <sup>2</sup>
Rate of loss from long term body stores	High rate ~1/100 days	High rate ~1/100 days
Rate of release from long term stores	under investigation	

Fig. 1. Elimination of soluble and insoluble cobalt in the rat.

Soluble cobalt is being used as a control to check that our results are similar to those already published (Barnaby and Thompson, 1946). If results on other materials are comparable, the first three experiments in Fig. 2 might be considered in man without going to extensive subcutaneous doses in the subject.

The conclusion is that, in the rat at least, no significant product radioactive cobalt is absorbed from the gut and that, therefore, any activity in the serum must have come from the lungs.

If the results are similar in man, since the distribution in the body is relatively stable, which it should be after the first week, differences in whole body radioactivity measurements can be equated with total excretion between the measurements. Thus it should be possible to estimate total body content of radioactivity. Radioactive counting might show the rate of the activity and, compared measurements, the clearance rate so that the input and dose to each organ could be calculated.

Further work is needed to see what can be done to increase the elimination rate. The Naval Radiological Protection Service will have been a generous co-operation in the management of people involved in extensive product calibration work in during nuclear submarine operations.

#### ACKNOWLEDGEMENT

I am indebted to Miss Anne Landon, of the Institute of Naval Medicine, for doing most of the experiments on rats on which this paper is based.

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## HOT-CLIMATE FATIGUE IN THE FAR EAST FLEET 1966-1968 SURVEYS OF LAY OPINION

By H. R. Madsen

### SUMMARY

From a subjective survey it was found that 54 per cent of officers and 52 per cent of ratings considered themselves too efficient, and 24 per cent of officers and 46 per cent of ratings considered the weather too healthy in the Far East than in Home Waters.

The outstanding cause of loss of efficiency was a general lethargy which the majority of both officers and ratings attributed entirely to the climate.

Compared with a similar survey in an air-conditioned ship in 1954 the percentage of personnel too efficient had decreased from 60-63 per cent down to 50-60 per cent and of those too healthy from 70-75 per cent down to 40 per cent. There is still, however, ample room for further improvement.

*For a climate which is colder the same obvious inclination — Hypocriticism.*

*Tropical fatigue has replaced the weather as a topic of polite conversation. There is little point in discussing the weather when it is so hot or so cold, as it was 19 years ago and will be tomorrow. — Macpherson*

### INTRODUCTION

That a certain type of ill condition based on life in the tropics for a European has been recognized since the earliest days of colonization (Ellen, 1845) and, particularly in its more extreme or hazy forms, has occupied much attention in general as well as medical literature (Foucault 1851; Kepling 1867; Orrell, 1955 and Somers Macpherson 1955).

The Chinese has also shown both interest and concern. The Bishop of Singapore (1900) in a letter to the *Straits Medical Journal* headed "Mental instability and brain down in the Tropics asked: 'What is the cause of the upset of mental balance which is so common in the tropics?' also, he said, sought from personal experience or loss of judgment to history or statistics and quoted a number of analogous foreigner friends as examples.

He received a wide variety of answers to his question in a special correspondence over the next eighteen months which was summarized by Kuhn (1917), and which included some less commonly accepted causes, such as sun glare and a sort of relief from the discomfort state of the atmosphere and the absence or presence of wind; the Medical and Natural being collected in *Notes on "La Gripe" in the Indies* (Mackintosh Clunbury 1943) and an equally pertinent story how hot weather would being associated with a similarly named forest down, "La Chouvailla" in *Paraguay Clunbury* (1944).

Between the two world wars, *Tropical Neurosis* was a frequent topic in medical journals and it appeared as a chapter heading in Manson's *Tropical Diseases* in the 10th edition in 1919. *Tropical Neurosis* was used by Macdonald Critchley (1933) in his Croonian Lectures which reviewed experience of the Problems of Havel Wexler under Chinese influence during the Second World War. Subsequent experimental work in the Artificial Asphyxiation Unit at the National Hospital, Queen Square, and in the R.N. Tropical Research Unit in Singapore from 1944-45 arising from these problems, was summarized by Mathewson (1955).

Manson's 10th edition in 1919 recognized the importance which *Tropical Fungus* had assumed during the Second World War, referring particularly to Mathewson's commission to determine the nature and incidence of *Tropical Fungus* (this fungus, 1945) amongst R.A.F. ground crew in New Guinea and other tropical areas and at the present time, with the more or less satisfactory control of most tropical diseases in towns for experience in urban areas or on ships, and the widespread use of air-conditioning, interest now lies especially in those environmental conditions which lead to considerable loss of efficiency or of enjoyment of health without the actual occurrence of recognizable clinical disease.

The validation of New Guinea for *Tropical Fungus* (1945a) outlined in this paper, recognizes that tropical heat may occur outside the Tropics, as in Madrid or New York, and that some tropical areas at mid-latitude climates, such as Nairobi or the Cameron Highlands, have pleasant equable climates.

#### *Air-Conditioning in H.M. Ships*

The habitability of H.M. Ships at hot climates has been handicapped by the inability even of air-conditioning, but the experience was gained during routine hypoxic exposures of ships in the Far East between August 1943 and February 1944 that there was still ample room for further improvement. Some deficiencies were detected in design both of ventilation and of operation of various systems, and it also seemed possible that some design standards might need modification to achieve lower effective temperatures.

The present study was undertaken to discover if this personal feeling of some disappointment with the results of air-conditioning in H.M. ships was supported by the effect on the personnel living on board, and if there was room for further significant improvements in their health and efficiency.

However carefully the environment may be controlled, thermally, chemically and bacteriologically the only way to determine how a person feels in that environment is to ask him the question, and in 1944 Surgeon Commander (now Captain) P. F. Ellis asked a number of persons ashore in Singapore, on a cruise, and on a return ship whether they felt less, more or as healthy, and less, more or as efficient as the Far East then in comparably conditions in the United Kingdom or Home Waters. This survey, of his opinion (Ellis, 1952a) was, of course, conducted in air-air-conditioned ships and it was thought that, by using a similar method and questionnaire in the present enquiry to produce comparable results, a useful subjective assessment of the present benefits of air-conditioning might be obtained together with some indication of the degree of difference still remaining.

## METHODS

A pilot survey was first conducted in a submarine depot ship and the results were considered to be sufficiently interesting to justify further surveys, which were carried out in four submarines, three frigates and a 'County' class guided-missile ship.

The results from different ships were in general very consistent but, unfortunately the samples from the frigates were not statistically satisfactory and they were not therefore analysed in the same detail as the remainder. For brevity, the results from all the other ships have been considered together in the following tables. A fully detailed report has been submitted to the Command Factors Sub-Committee of the Royal Naval Personnel Research Committee.

## RESULTS

*Losses in Health and Efficiency*

Questionnaires were completed by 70 officers and 321 ratings, all of whom had been on the Far East Station for at least 3 months, and Table 1 shows that more than half of both officers and ratings considered themselves less efficient on the Far East, while a quarter of the officers and over a third of the ratings thought they were less healthy.

TABLE 1  
Perceived Loss Efficiency and/or Loss Health

	Total Number	% Less Efficient	% Less Healthy
Officers	70	54	24
Ratings	321	53	40

*Causes of Loss of Efficiency*

The questionnaire provided an opportunity for the less efficient and less healthy to give examples of their feelings and to attempt some explanation of them.

TABLE 2  
Causes of Loss of Efficiency

Symptom	Frequency of Symptom (As % of personnel complaining of loss of efficiency)	
	Officers (Total No. 70)	Ratings (Total No. 321)
Exhaustion	53	74
Reduced Concentration	4	10
Reduced Initiative	23	25
Increased Irritability	30	33
Personality Change	40	74
Morale Decline	24	8

Table 2 shows that the most widespread cause of loss of efficiency was a general fatigue, which was mentioned by approximately three-quarters of all affected personnel.

together with varying proportions of associated symptoms of reduced concentration, irritation and a lowered sense of responsibility. Personality changes reported by 1 in 4 officers and 1 in 4 ratings were usually specified as an increased irritability or short temper.

It is curious that memory defects which were complained of by 1 in 4 affected officers, and were sufficiently conspicuous to be generally referred to as 'Singapore Memory' were not mentioned at all by ratings.

#### *Importance of Climate*

The majority of both officers and ratings attributed their troubles entirely to the climate. 24 per cent of officers and 17 per cent of ratings mentioned other factors in addition, such as faulty ventilation or food and water, but only 3 per cent of officers and 5 per cent of ratings considered the climate of no significance.

#### *Complaints attributable to Exercise Scheduling*

TABLE 3  
Symptoms Attributable to Exercise Scheduling

Symptom	Frequency of Complaints Over 1% of personnel complaining of loss of efficiency	
	Officers (Total No. 181)	Ratings (Total No. 275)
Discomfort	17	30
Interference of Sleep	17	12
Loss of Interest	3	15

Table 3 shows that, of the symptoms probably attributable to exercise scheduling, discomfort and difficulty in sleeping were undoubtedly troublesome, but more than a third of both officers and ratings complained of general discomfort which was usually specified as sweat continually running into the eyes or dripping onto work on deck or beach.

#### *Comparison between 1941 and 1943-1945 (officers and ratings combined)*

TABLE 4  
Personal Loss Efficiency and Loss Health

Ship	% Loss Efficiency		% Loss Health		Total Nos.	
	1941	1947/5	1941	1947/5	1941	1947/5
Destroyer	54	60	55	62	62	261
Cruiser	54	50	75	70	64	121

Table 4 compares the results of the present survey with Ellett's figures for 1941 and, though there has clearly been a considerable improvement, the fact that between

50 and 68 per cent of personnel still consider themselves less efficient and 48 per cent less healthy even in a cabin at least for further cruises. If not, necessarily yet for shore and even despite any tendency to complacency over the present standards of air conditioning.

TABLE 3  
Symptoms Aids Results in Executive Landing

Symptoms	% of personnel complaining of symptoms			
	Upper Bay		Crews	
	1966	1967	1966	1967
Discomfort	60	36	33	43
Disorders of Sleep	47	8	43	8
Head Disorders	32	8	49	1

Table 3 shows a most marked and very consistent improvement in symptoms attributable to excessive sweating in a depot ship and a cruise in 1967/8 compared with 1966.

#### DISCUSSION

Care must be taken in drawing conclusions from a comparison of subjective surveys conducted by questionnaire some seventeen years apart, but there can be little doubt that the considerable improvement in general habitability over that period, which has been demonstrated, has been mainly due to air conditioning.

However, more than half of the personnel questioned still considered themselves less efficient in the Far East, and more than one third less healthy so that there is clearly ample scope for further improvement.

No inference was obtained, of course, from these surveys, of the precise degree of the inefficiency which was recorded. Such measurement is now required to assess the full significance of the problem. This would mean detailed environmental measurements (Dufford, 1946; Wilson, 1965) with simultaneous subjective measurements of thermal comfort (Baker, 1957a), and measurements of human performance under the observed conditions, and possibly also under controlled experimental conditions (Mellor-Smith, 1959a).

This would clearly be a full-scale research project as opposed to the modest field survey just described.

#### SUMMARY

1. Questionnaires were completed by 76 officers and 334 ratings serving on ships of the Far East Fleet in 1967-8 who noted if they felt more, less or as efficient and/or healthy in the Far East compared with service in Home Waters.
2. Those who felt less efficient or less healthy were asked to give examples of their feelings and to attempt some explanation of them.



## THE MEASUREMENT OF CLIMATIC STRESS IN THE ROYAL NAVY

By J. DUNCAN WILSON

### ABSTRACT

Exposure to adverse climatic conditions is an occupational hazard in the Royal Navy. Wind-Chill, effective or corrected effective temperature and Wet-Bulb Globe-Thermometer (WBGT) Values, are commonly used to evaluate climatic stress and their application in preventing thermal injury is discussed. Recent developments in protective clothing, for use in hot and cold environments, and thermocouple instrumentation are briefly described.

Although climatic stress has always been one of the more important factors affecting the health and well-being of naval personnel, some confusion still exists regarding its measurement and the interpretation of thermometer data. It is, therefore, intended to clarify this situation, so far as the Royal Navy is concerned, and to review the progress which has been made during the last four years in assessing the effects of various thermal environments.

### *Index of thermal stress*

Many indices of thermal stress have been described and discussion of them all is outside the scope of this paper. However, Allen (1951) gives a comprehensive description of the more widely used indices of heat stress and mentions in the Royal Navy and a contains a valuable bibliography on the subject. The useful paper will, it is hoped, provide the basis for a revised version of the well known *Wet-Moment Index No. 17* (Gifford, 1944).

Three indices of thermal stress are commonly adopted by field investigators in the Royal Navy to describe climatic conditions ranging from extremely cold to moderately hot. These three indices are not necessarily the most accurate in predicting the physiological stress imposed by a given thermal environment but they have the merit of being relatively easy to derive from measurements made with simple thermometric instruments and are, therefore, suitable for use in the Fleet by investigators, whose principal interest is not perhaps in the field of climatic physiology but who nevertheless have responsibility for the health, safety and efficiency of men exposed to adverse climatic situations.

Figure 1 represents, in diagrammatic form, a climatic spectrum ranging from temperatures which are unendurably cold, whilst completely enveloping protective clothing is worn, become exposed flesh (even, within a very short time, is damaged or lost) to complete protective clothing is necessary if exposed skin and mucosa are not to be scalded or burned. The temperature values indicated on the scale are not simple air temperatures but wet index temperatures, the significance of which will be discussed.





(4) the lower end of the scale where water void is the challenge. In thermal stress test, it is described in terms of Warfield Values. Three values are derived from either or appropriate many measurements of dry-bulk temperature and wind velocity using, in measurements where water barriers and bulk temperature would be measured.

less but the effect of wind-speed is extremely important. Some knowledge of survival times at various wind chill values is essential. Most personnel of the Royal Navy are frequently exposed to very cold conditions, and useful pamphlets on this subject are available from the Royal Naval Air Medical School. The Department of Occupational Medicine and Hygiene of the University of Naval Medicine has collaborated to a considerable extent with other bodies in the design and testing of protective clothing for use in cold climates.

Higher up the scale, between under temperatures (15°C (59°F) and 10.1°C (50°F)) temperature levels have been described in terms of effective or corrected effective temperatures or wet-bulb globe thermometer (WBGT) values and the numerical values and associated significances have been related to a number of publications to form a logical sequence. Originally derived in 1933 by Houghton and Typhlogon, the effective temperature scale of thermal comfort is derived from measurements of dry bulb and wet bulb thermometer temperatures and air velocity with the aid of nomograms. Two scales are available, namely the basic and survival scales of effective temperature applicable to men exposed to the wind or sunless light indoor climates respectively. A modification of the effective temperature system to make an approximate allowance for the effects of radiation heat has been proposed by Bedford (1944). This modification involves the estimation of globe-thermometer temperatures for dry-bulb temperatures in the derivation of values from the effective temperature nomograms and, when this correction is used, the resulting values are known as corrected effective temperatures. Effective and corrected effective temperature values are the officially recognized indices of environmental stress used in the Royal Navy and from Fig. 1 it may be seen that the highest recommended temperature for living spaces allowed ships in the tropics (23°C, 73°F) and the maximum tolerable temperatures for living and working spaces (19°C, 66°F) have been described on these terms. Strictly speaking, effective and corrected effective temperatures are not indices of thermal stress, but of comfort, although they have nevertheless proved valuable in both contexts and by using suitably modified nomograms, allowances for work rate, a minor important factor in climatological stress, may be made.

Useful though the scales of effective and corrected effective temperatures are, the derivation of particular values can be a time consuming task, principally because the direct measurement of air movement is required which, if the Kola thermometer is used takes a considerable time and the latter one, if used incorrectly, gives variable results. There was therefore a need for a simpler index of environmental warmth for field use which would not require the use of instruments or demand the direct measurement of air movement. Such an index is the Wet-bulb Globe thermometer index (WBGT index) described by Tinsley and Minard in 1957 which has been widely used in the Armed Services of Great Britain and certain other countries, namely the United States of America and Canada. The WBGT index is simply derived from the formula:

$$\text{WBGT} = 0.7 \text{ wet bulb} + 0.2 \text{ globe thermometer} + 0.1 \text{ dry bulb temperature}$$

In many instances where radiant heat is an important factor the following simplified formula may be used:

$$\text{WBGT} = 0.7 \text{ wet bulb} + 0.3 \text{ dry bulb temperature}$$



survived through Marine Corps training in the United States and because of its simplicity it is widely used for use in the field. Primarily, however, it was an index of climatic severity intended for use in nuclear environments with a high radiant heat load and its usefulness in nuclear environments was explored until a number of surveys were, mostly sponsored by the Clouston Parsons Sub-Committee of the Royal Naval Personnel Research Committee, demonstrated a high degree of correlation between WBGT values and effective or corrected effective temperatures in the same situations, indeed where no movement is within reasonable limits. WBGT values up to about 32.2°C (90.0°F) effective or corrected effective temperatures have been shown to be virtually identical. It may well be, therefore, that the description of the WBGT index as 'the poor man's effective temperature' is too harsh a judgment on this very useful index of thermal stress.

Above a WBGT value or effective or corrected effective temperature of about 32.2°C (90.0°F) it becomes impossible for man to live but in these environments and their skin temperature will, therefore, rise as it is determined by the severity of the climate and their level of physical exertion. If man has acquired his work so that extremely hot environments they must either be protected by means of air-conditioned suits or similar means or alternatively their time of exposure to the environment must be limited if the danger of heat stress is to be avoided. Such limitation of exposure of unprotected man is probably up to a temperature of about 52.0°C (123.6°F) with 100 per cent relative humidity which was found by experiment (unpublished report) to be the threshold of pain. Above this level, full protective clothing must again be worn for climate reasons. Experimental work, sponsored by the Clouston Parsons Sub-Committee of the Royal Naval Personnel Research Committee into the tolerance limits of young, fit, unacclimatized men dressed in general engineering clothing and working at a constant rate in extremely hot and humid circumstances where the air speed was constant and the mean radiant temperature was similar to that of temperature has been carried out and reported by Bell, Walker and Watts (1967). From the results of this work a curve has been constructed (Fig. 1) relating suit exposure time, mathematically derived from observed mean painless limits, to a measure of climatic stress. It was found that the best practical description of the climate to fit the experimental data was obtained by the summation of  $GP$  and  $4000 + 0.3$ -dry-bulb temperature where, as may be noted, is identical to the modified formula for the computation of the WBGT index when radiant heat is not an important factor.

#### RECENT PROGRESS AND FUTURE TRENDS IN COMBATING THE EFFECTS OF ADVERSE THERMAL ENVIRONMENTS

##### (a) *The cold environment*

The Occupational Medicine and Hygiene Department of the Institute of Naval Medicine has not been directly concerned with research into the physiological effects of exposure to cold environments or adaptation to such conditions except insofar as the design and testing of protective clothing has necessitated the measurement of

body temperatures and various other physiological parameters (1941). Reported Proceedings against the effects of cold climates, however, is essentially a matter of providing the body with adequate insulation so that metabolic heat loss is prevented. As the same term, clothing must be windproof to prevent the dissipation of this heat and waterproof in order that the insulation value may be maintained. Since the first Symposium on Naval Medicine held in 1940, much progress has been made towards the achievement of this aim.

(9) *The cold-water environment*

Deep-sea divers escape techniques a submarine may descend from a moderate submergence from considerable depths and reach the surface with minimal danger. Once on the surface, however, he may well be faced with the problems of surviving possibly in a very cold environment, whilst he awaits rescue.

The Submersible Escape Immersion Test (SEIT) has been tested extensively by observers from the Royal Naval Air Medical School and the Institute of Naval Medicine and the findings reported (Rye 1967). In these trials men wearing the SEIS were immersed in water at 1°C whilst their deep-body temperature, skin temperature and metabolic rate were recorded. Electrocardiograph records were also made during this experiment. It was deduced that under the conditions of this test, survivors would be unlikely to suffer cold injury after 12 hours immersion and would probably survive for about 24 hours. Similar conditions were reached following like trials in the United States of America (Hall, Nohel and Ristic 1967). It must be admitted, however, that there is a considerable difference between laboratory conditions and those found in practice and the Clothing Panel of the Royal Naval Personnel Research Committee is at present preparing a programme for testing the SEIS at sea where the influence of wind, waves and sea sickness will also be taken into account.

(10) *The cold-dry environment*

During the course of deep-sea dives, naval personnel may be exposed to very low ambient temperatures. The problem of protecting them against the adverse effects of such exposure is that of providing a sufficiency of insulated clothing which is windproof and waterproof whilst at the same time allowing freedom of movement and as high a degree of thermal comfort as possible. New research and ideas have enabled much improved foot weather clothing to be developed and, under the sponsorship of the Clothing Panel of the Royal Naval Personnel Research Committee, the Occupational Medicine and Hygiene Department of the Institute of Naval Medicine has collaborated with the Royal Naval Physiological Laboratory, the Director of Ventilation and the Royal Naval Air Medical School in testing various combinations of foot weather clothing at the British Antarctic Corporation's Biosphere Chamber, Weybridge in a temperature of -20°C and wind speed of 30 knots. Two trials have taken place since the first Symposium on Naval Medicine: the first in 1966 reported by Dennis, Wilkins and Wilson (1966a) and the second in May 1968 a report on which is in preparation. From these trials it has been possible to recommend a foot weather clothing assembly con-

period of available Yeomanling flood lamps, which will protect men for a period of at least two hours in the conditions described above.

To date it has not been possible reliably to protect the hands for a period of two hours in three cold conditions without electrically heated gloves unless a serious limitation of manual dexterity is accepted. However, one really suitable type of electrically heated gloves have been used which are highly satisfactory and it should be possible to run them for several hours from small rechargeable batteries carried on a belt. It is hoped to try a waterproofed and lightweight version of these gloves fitted with a battery power supply in early 1972.

The problem regarding protective goggles however is still unsatisfactory. Available types of goggles rapidly mist up and become covered with ice. One obvious reason. A prototype double-glazed goggles based on the working type of goggles was tried in the 1969 trials and was found to be superior to the current single-glazed version although not entirely satisfactory. A full further development of the design should be available for trial in early 1972.

(c) *The issue of thermal comfort and tolerability.*

An effective temperature range from about 12°C (53°F) to 32°C (90°F) cannot meet all the climate encountered in today's navy ships aboard HM Ships. It is also the point at which there has been confusion and even controversy over the most appropriate index of environmental warmth for use in the Royal Navy.

Although a high degree of correlation between effective or corrected effective temperature and WBGT values over this range has been reported it is nevertheless felt that there is a place for both systems in naval environmental medicine. Because the effective temperature system makes a direct allowance for air movement and also because it was primarily devised as a means of assessing thermal comfort it is thought that this scale of warmth should be used for ship design and similar purposes where thermal comfort is the aim. When the Medical Officer responsible for the care of men exposed to higher temperatures requires however, a suitable indication of when the climate has become so severe as to make the occurrence of heat casualties a possibility, how probable such an eventuality might be and what recommendations he might wish to encourage the men. To be of maximum use such an indication should be quickly and easily obtained without the use of charts and nomograms and, if necessary, by using only the simplest of thermometers and sensors. It is suggested that the WBGT index is used for use in the rest of thermally stressful situations and, if it is remembered that in deriving safe-limits one takes the man working in extremely hot and humid climates, often under several conditions the modified WBGT formula was found to be the best practical description of the environmental wet bulb that the organism is faced in using the WBGT index in such situations is relevant.

Recent research work carried out under the sponsorship of the Climate Factors Sub Committee of the Royal Naval Personnel Research Committee involving the Occupational Medicine and Hygiene Department of the Institute of Naval Medicine has included today's navy ships in submarines and various ships and the estimation of an electronic instrument for direct measurement of the WBGT index. Unusually such aboard patrol submarines operating in tropical waters confirmed that the thermal

environment was, under certain conditions, satisfactory although at the most modern vessels conditions were quite reasonable when at normal cruising states. As a result of the surveys, however, standards have been considerably improved and will doubtless continue to be improved as the other classes of patrol submarines are withdrawn from service.

Only one habitability trial has been carried out recently on a surface ship operating in tropical waters and this was aboard a ship of the Leander Class. It was, however, a very uncomfortable trial carried out in conjunction with representatives of the Director General Ships and the Nuclear Biological Chemical and Damage Control School, HMS *Plume*. The findings of this trial have been reported to the Climate Forces Sub-Committee of the Royal Naval Personnel Research Committee (Warrior Unit) and, although the habitability of certain compartments could be improved the thermal environment aboard this ship was, in general, very satisfactory. Only some insufficiency of the thermal conditions of ships will, however, prove that the best possible standards of habitability will be maintained and it is hoped that similar trials will be conducted on other types of ship.

The conduct of temperature surveys, particularly in underpowered submarines where the use of surface thermometers is forbidden, has been considerably eased since the Royal Naval Personnel Research Committee's WDOG (Moore) became



Fig. 1. (1) Habitability trial equipment. (2) Habitability trial equipment.

available. A prototype model of this instrument was shown at the first Symposium on Naval Medicine and a report on its performance has been published (Whittem, 1944). Since that time an improved and more versatile model has been produced which will measure directly WING indices dry bulb wet bulb and glauc-thermometer temperatures, instantly observed temperatures within the range  $(-30^{\circ}\text{C})$ — $(42^{\circ}\text{C})$ , surface or ambient temperatures from  $-80^{\circ}\text{C}$  to  $+90^{\circ}\text{C}$  and air speeds from 0.500 ft/sec (0.552 m/sec) (1 mph) and 0). Several of these instruments have been on trial in the Fleet and in the laboratory and have been shown to be reliable and robust. A report on the trials is shortly to be available. Similar instruments are on order for all British nuclear powered submarines and basically similar instruments have been or are being obtained by the Army and Royal Air Force.



Fig. 4. The WING Instrument for Blood Flow

For the future, open-breath studies, both steady-state and light load of working men, are required into the effect of working in temperature, in the upper end of this range and in particular the effect on the performance of skilled work. Such experiments, particularly when, secondary rhythms are a factor for consideration, are likely to involve the exposure of subjects to the hot climate for several days or even weeks. Facilities for carrying out this type of experiment are being incorporated into the Submarine Medicine and Environmental Hygiene Laboratories, which are shortly to be built at the Institute of Naval Medicine.



(a) *The use of wet-bulb globe temperature*

Research work into the tolerance limits of man exposed to extremely hot environments has been sponsored by the Chinese Fraternities, Sub-Committee of the Royal Naval Personnel Research Committee, and carried out by workers from the Liverpool School of Tropical Medicine, the Medical Research Council and the Occupational Medicine and Hygiene Department of the Institute of Naval Medicine. The results of our series of trials involving exposure to very hot and humid environments, have been reported (Gill, Masters and Mann, 1965) and a report on similar trials in which the climate, even at least as stressful but much less humid, is in preparation. The information is required because conditions in the engine rooms of gas turbines powered ships would, under certain circumstances, rise to very high temperatures but the relative humidity could be very low.

While the Safe Tolerance Limit Curve (Fig. 2) is really applicable to man wearing normal degree winter clothing, it may be used as a useful temporary expedient, since no other information was available on predicting safe tolerance limits for men wearing completely impermeable suits and respirators in a hot environment. Under these conditions the main environment would be impermeable but will be saturated with water vapour which will not evaporate, owing to condensation through the suit fabric, so that of the wet-bulb dry (WBD) thermals, the dry bulb temperature of the ambient air is used in place of the exposure. A 7 wet bulb = 8.5 dry bulb temperature chart (Fig. 3) could be used to predict safe exposure limits for men in closed

The alternative to limiting men's exposure times to temperatures in this line is to provide gas-ventilated suits or protective clothing cooled by other means. Air-ventilated suits, which have been available for some years, are now a standard ventilating store item and should therefore be available to ships. A modified and improved version of the Hishik cube used to cool the air supplied to the man in under development at present. The Mark II Hishik cube is shorter and lighter than the Mark I version and is said to be less noisy and will operate at lower air pressures. Trials of this new Hishik cube are to take place shortly.

(b) *The need of initially low temperatures*

The level of warmth at which environments become so hot as to be painful to exposed man has been the subject of some discussion but it was found, by accident during the trials in which men were exposed to hot and humid environments that an environment at a temperature of 32.8 °C (91.0 °F) saturated with water vapour was probably fatal. Even at temperatures 1 degree or so lower than this conditions were intolerable owing to difficulty in breathing caused by uncontrollable coughing. At such temperature levels, therefore, it is essential that men exposed to them wear complete protective clothing suitably cooled, such as the air-ventilated suit fitted with a Hishik Tube of heat exchanger is to be avoided.

Occasionally, however, men may be exposed accidentally to initially hot environments as happened in 1962 when a main steam pipe burst in the boiler-rooms of HMS *Caernarfon* and 3 men lost their lives. In this instance the need is for an insulated suit which will provide protection to the wearer for a time sufficiently long for him to effect an escape. Such a suit has been developed under the sponsorship of the Clothing

Panel of the Royal Naval Personnel Research Committee and tested by observers from the Occupational Medicine and Hygiene Department of the Institute of Aviation Medicine and the Royal Naval Physiological Laboratory.

Following successful trials of the Mark III Hot-Escape Suit (Walters, Young and Wilson Davies, 1966), further trials took place at the Institute of Aviation Medicine, Farnborough, in which volunteer subjects were exposed in a climate of 70.0°C dry bulb and 22.0°C wet-bulb temperatures. The test regimes were experienced when the subjects stood still for 15 minutes or when they simulated an escape by standing still for 5 minutes and then ran/climbed, as fast as possible for at least 20 cycles of 3 steps up and 3 steps down. Engineers were loaded in all cases by carbohydrate build-up within the suit rather than by intolerable thermal discomfort. The suit could be donned even by inexperienced subjects within 20 seconds and it therefore seems that the Mark III Hot-Escape Suit should help to prevent repetitions of the tragedy which occurred to *Black Crow*.

### CONCLUSION

Much progress in the field of Climatic Physiology has been made in recent years and it has been an honour for the Occupational Medicine and Hygiene Department of the Institute of Naval Medicine to be associated with so much of it. The hazards of exposing men to adversely hot or cold environments, two well-known but unemphasized and forgotten are required if progress is to be made towards solving the many problems involved in controlling these hazards. Such encouragement and available help and advice has been given in recent years, by the Medical Director General (Naval), the Royal Naval Personnel Research Committee and Surgeon Captain F. P. Ellis to whom, in particular, a debt of gratitude is owed for his great personal interest.

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## PHYSICAL FITNESS AND EFFICIENCY IN THE ROYAL NAVY

Surgeon Commander D. F. MURPHY discussed the problems of determining parameters of physical fitness. A considerable quantity of data has been submitted to detailed analysis. The results of which will be published in due course.

## A SURVEY OF RECENT MOTION SICKNESS RESEARCH

By J. J. Brand

## SUMMARY

The only drugs which appear to give consistently reliable protection against symptoms are hyoscine, diphenhydramine, cyclizine and promethazine. Field trials have indicated dose levels of hyoscine and cyclizine which can be expected to afford good protection with a minimum of side effects. Human and animal studies are described which have helped to clarify the mechanism and site of action of motion sickness drugs. Experiments carried out on the rats at sea indicate that nausea and vomiting can be controlled by a dose of 0.2 milligrams of hyoscine hydrobromide given intramuscularly.

*Introduction: A Review of the Literature*

The aim of this paper is to give a brief review of the work which has been carried out in the past five years and to indicate the advances in knowledge which have resulted from it. The work is by described began in 1964 at the Institute of Naval Medicine, Aberdeen, with the support of the Royal Naval Personnel Research Committee and the Medical Research Council and with the advice of Professor W. L. M. Perry of the Department of Pharmacology of the University of Edinburgh Medical School and has since continued at the RAF Institute of Aviation Medicine, Farnborough.

At this time the problem concerning the effectiveness of drugs used in the prophylaxis of motion sickness was confused. Many different studies had been carried out under a variety of experimental conditions but these had yielded results which were often at variance with one another. At the suggestion of Professor Perry a review of drugs used in motion sickness in the previous 20 years was undertaken (Brand and Perry, 1966).

This review gave much useful information and was the foundation of subsequent research. The main conclusions were as follows:

- (a) It became possible to resolve some of the conflicting findings concerning the efficacy of various drugs by allowing for differences in experimental conditions, especially in relationship to size of dose, duration of motion and interval between dose and exposure to its effects. A great deal of confusion had arisen because too little was known about the dose response relationships of the various drugs and also their time course of action.
- (b) Of the many preparations tested, only four appeared to give consistently reliable protection against symptoms. These were: hyoscine, diphenhydramine, cyclizine and promethazine.
- (c) The mechanism of action of the effective drugs was not clearly understood. It was shown that it could not be related to certain recognizable pharma-

subjected properties which they had in common or none (for example with morphological or non-linguistic property).

- (iv) The site of action of effective drugs was also effective but there were indications that this might be in the level of the cholinergic input onto the nucleus or on the integrity of its connection with both.
- (v) As mentioned above there was no dose response information for any of the effective drugs. However, because a large number of studies had been carried out using a range of dose levels of hyoscine but in different experiments it became possible to construct dose response curves for that drug by the application of variable statistical techniques. This indicated that the dose level of hyoscine frequently recommended at that time (10 mg of the HBr-571 mg of *d*-hyoscine base) was perhaps higher than necessary. Further, some new evidence had now been obtained that protection against motion sickness was less dependent on peripheral anticholinergic actions (which were clearly, responsible, for the unwanted side effects of the drug) it appeared that it should be possible to achieve good protection against symptoms with a much smaller dose level.
- (vi) There was no reliable laboratory test for assessing motion sickness. This meant that the only satisfactory and reliable way of studying such a drug was by a carefully controlled study carried out on human volunteer subjects. The absence of any convenient laboratory test had clearly delayed the discussion of the site and mechanism of action of these drugs and also the development of new preparations.

#### Further investigations (a) Field Trials

The information obtained from this survey led to further investigations of the effectiveness of various dose levels of drugs in protecting against symptoms induced by motion and also to detailed studies of their time course of action.

The interesting prediction that effective protection against motion sickness symptoms could be achieved by using smaller doses of hyoscine with a concentrated solution in the treatment of unwanted side effects required confirmation under conditions of motion. An experiment was therefore carried out to clarify this point using the tests applied in the studies of artificially produced waves. Hence there was no information relating response to dose for outcome our aim was to obtain similar information for that drug and also to provide an estimate of its potency relative to that of hyoscine. The effect of both drugs on tests of mental performance carried out both when and when not exposed to the wave was.

This investigation confirmed that small doses of hyoscine gave efficient protection and that the percentage of subjects who experienced reduced side-effects corresponded very closely with that which had been predicted on the basis of dose response information derived from the literature review. Further, the tendency of side effects was reduced but with very little loss of protective activity. The tests of mental performance showed no difference at the dose levels used in the experiment. In fact the reverse was true and improvement in the scores of the tests was observed after effective

mechanism, this was attributed to control of symptoms (Bland, Colquhoun, Gould and Perry, 1967).

Further experiments were then carried out when in December

- (c) The time course of action of lysergic acid given by mouth at various dose levels, also showed that the time to peak effect of the drug was two to three hours after a single oral dose and that its duration of action was less up to four hours.
- (d) The relationship of time of dose to impairment of mental performance, the time used (which were derived by the Applied Psychology Research Unit, Cambridge) depended on speed of individual compensation and also on vigilance. No impairment was detected after doses of lysergic acid ranging from 0.1 to 0.7 milligrams of the base or after cyclizine hydrochloride at dose levels ranging from 15 to 100 milligrams. This result probably does not mean that no impairment of higher mental functions occurred but rather that our tests were not sufficiently sensitive to detect them (Bland, Colquhoun and Perry, 1969).

From the results of this work it now became possible to recommend drugs, which were of proven reliability and in the case of lysergic acid and cyclizine, to suggest dose levels which could be expected to afford good protection against symptoms with a minimum of unwanted side effects.

#### (3) Laboratory Studies

Further laboratory studies were carried out in an attempt to develop a convenient bio-assay test and with the hope of clarifying the mechanism and site of action of various sedative drugs.

#### Studies in Man

The survey of the literature indicated that the responses which can be elicited by sensory tests of labyrinthine function could be modified by some motion sickness drugs. Therefore further studies of the subjective turning sensation and nystagmus, which can be evoked by such tests were carried out. The findings were as follows:

1. The responses elicited by labyrinthine stimuli of this kind were very labile to modification by labyrinthine phenomena and this could readily confound any drug effects. Therefore, control drugs and analysis of the results was needed (Bland, 1968).
2. A dose of lysergic acid of 0.1 to 0.4 milligrams given sublingually to unhabituated individuals shortened both the duration of turning sensation and delayed nystagmus (Bland and Bland, 1964).
3. When lysergic acid was given by mouth to a group of habituated subjects it produced no further depression of these responses (Bland, 1969).
4. Further studies revealed that the effects produced by lysergic acid can also be observed after carbimazole treatment (a drug with no anti-motion sickness properties) which indicated that they were probably related to CNS-depression and not to any more specific anti motion sickness activity (Bland, 1969).

#### Study Methods

1. In the initial treatment programme a constant rate infusion device was used and was replaced (1) after 100 mg, (2) after 200 mg, (3) after 300 mg, (4) after 400 mg.
2. Under a strict protocol, patients were treated with hydrous sodium chloride, all except a final 100 mg, according to the amount of the desired decrease in body fluid volume. Thus, once the infusion device was started, the amount of the previous effect due to it had been already given, and it was

Although studies of the effect of intravenous sodium chloride, especially with pooled data, to give a rough estimate, may have helped in defining the amount of the rate of action of each dose of 100 mg, a new form of management.

#### Recent Applied Research

In recent months research has been directed towards the study of treatment administered to patients with liver disease. This could be modified within physiological conditions. Studies exposing to uniform patterns of motion up to 100 mg in a day may lead to the inclusion of symptoms of motion sickness. This is not only cause a rapid incidence of motion with loss of the will to survive and the ability to carry out survival procedures. The development of motion or vomiting does preclude the administration of drugs by mouth. Under such circumstances, parental administration of an effective drug could be of the greatest value in securing a rapid control of symptoms. The same course of action of intravenously administered hyaline has been studied under laboratory conditions and various results of administration, pulse rate, pupil diameter and mental changes have shown that (phenomenon) the drug is rapid with a peak effect being achieved at one to two hours after a dose of 0.2 milligrams of the hydrochloride and that measurable effects persist for up to eight hours (Bickel 1969).

Recent studies carried out on rats indicate that a dose of 0.2 milligrams of the hydrochloride given intravenously can be expected to control symptoms of motion and vomiting when these have developed. Side effects were not severe and the subjects remained alert and cooperative, although there was a slight incidence of dry mouth in the treatment group than in the control group the difference was not significant at the 5 per cent level of confidence. The outcome may possibly represent a further advance in the management of the condition under circumstances which preclude the administration of medication by mouth and where it is desirable to retain more than one solution.

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# *Phyllis*

The following studies were completed during the Naval Commissioning Naval Medical Officer in the Royal Naval Medical Service, London and Plymouth, 1939-1945

## *Activities*

Health Services as a Complement of Gunner Training

Cancer Brackets for Royal Naval Medical Officers

Causes of Sickness, Wounding and Death in the Royal Navy from 1890 to 1914

The Chemical Aspects and the Control of Thermal Stress

Depressible Pressure Isolator for Naval Hospitals and Ships

Epidemiology of Urinary Tract in the Royal Navy

Gastric Biopsy Studies

Hyperbaric Oxygen Therapy in the Royal Navy

Immediate Psychography in Naval Color

Mechanics of the Black Foam

Manual Apparatus Minder and Alarm System

Wave Control

Physiology, Medicine in Submarines

Radar scope Scanning

Royal Marine Commando Company Management

Submarine Escape from crew Sea

Surgery of the Gastro-Duodenal Junction

Surgical Cystitis, Therapy

Synthetic Collagen in Naval War Cover in Sea

Underwater Research and Development

Vaccines

Water Filtration

Naval Radiological Protection Service

Schizophrenia Research



# Letters to the Editor

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## Modern Trends in Clinical Internal Disorders

On glancing through the Summer 1968 issue of the Journal in which is reported in detail Part II of the Symposium on Modern Trends in Medicine and Clinical Internal Disorders, I was struck by the absence of any reference to the work of one central medical observer who has written extensively on the subject of diet in gastro-intestinal and other diseases. I refer, of course, to the writings of Singapore Captain T. L. (Pete) Chow, MRCF, FRCSd.

Most medical officers of the arm, including myself, were inclined to take Pete's advice on diet with the proverbial grain of salt, and I think most of us considered him a faddist and ignored his advice altogether.

When I was MRCF of the Medical School (1953/56) and Peter Chow was Director of Medical Research, I was very impressed with his theory on the cause of certain diseases, and I persuaded him to give a lecture on his pet subject, 'The Significance of Nutrition Principles in Current Medical Practice'. This lecture was very well received by a large audience and I had it published in the Journal (1956). There was such a demand for reprints from many parts of the world that Pete decided to write for a wider public and this was the beginning of quite a series of interesting publications culminating in his latest book, *Dietetics: A Concise Textbook and the Nutritionist's Digest*, which has had two editions and a third is presently under a complete revision about 50% of the text.

His Peter Chow has been telling and writing someone all these years and should his work be completely ignored by the RS Medical Service? I think so, worth considering what some of the leading medical and surgical authorities have had to say about it.

In the Foreword to the first monograph, 'Fit Constitution and Concomitant Disease' (1957) Dr Percy Stocks, FRCP, CMG, who was Chief Medical Superintendent, General Regeneration Office, wrote: 'When endeavouring to learn about the aetiology of the cause of a chronic disease the reader's curiosity leads him on perhaps to go with few connecting bridges between hazy islands of ascertained facts. A philosopher is then tempted to look to the map and, with a flash of insight, make sense out of it. This hard and fascinating monograph may well prove, after more years of argument and investigation, to have done just that for curiously diseases.'

In the Foreword to the second monograph, 'On the Constitution of Various Years' (1959) Sir Harold David, FRCS, co-author of 'The Pathology and Surgery of the Vessels of the Lower Limb', wrote: 'In publishing this book, Singapore Captain Chow has, I think, done Westminster medical an admirable service. He has painstakingly analysed the Westminster way of life, particularly with regard to food, and curiously shows how it has affected the function of the nation, with consequent deleterious effects on the constitution and the structure of the vessels of the lower limb leading to varicose veins and thromboses, with the consequent physical and mental conditions. His facts, gathered from first class sources are marshalled with comprehensive skill and suggest the cause here they maintain that the fault lies in the Westminster way of preparing food and not with the conventional theory of congenital structural

defects of the time and that which . . . I mentioned this book as compared to a future modification of the *Watership* etc.

In the Foreword to Peter's third book, *Peter's Ulcer* (1962) Dr P. Vasey Jones, MD, FRCS wrote: "Sergeant Captain Clowes has brought together the available data on 'protein-stopping' in bone tools and the prevalence of ulcer. I personally accept the theory that this may be an important factor in ulcer production, not necessarily connected with the hydrochloric acid though this is the obvious link. I believe that Sergeant Captain Clowes's theme underlines an aspect of modern medicine which is important not only in relation to ulcer but possibly in many other conditions as well. Many even this he termed I has pointed out. His remedy advanced in this work is a simple and practical one, and would change the general attitude to the treatment of peptic ulcer in a most radical manner."

Peter wrote his next book, *Duchenne's Curvature Thoracolumbar and the Sacrocaudal Distance* in 1965 and Dr G. D. Campbell, MD, FRCS, Physician to the Duchess, Clowes of the King Edward VII Hospital in Durham, joined him as a co-author.

In the Foreword to this book, Dr Richard Dhill, MD, FRCS, Director of the Statistical Research Unit, Medical Research Council, and now Regius Professor of Medicine in Oxford, wrote: "Whilst the predictions that Sergeant Captain Clowes and Dr Campbell make in their book will prove to be correct seems to be true, but if only a small part of them do the authors will have made a bigger contribution to medicine than most University Departments of medical research could make in the course of a generation."

In the second edition of this book (1968) the authors were joined by Mr M. S. Fennell, MS, FRCS, Honorary Professor, Royal College of Surgeons, Senior Surgeon, Maudsley Hospital, London.

Many physicians and surgeons working in India, Africa and elsewhere throughout the world have given support to Peter Clowes's conception of the Sacrocaudal Distance and a translation of his book has been published by the Germans. A reviewer in the *Lancet* stated that "Nurses in medicine should find it well this ground and something back" and in the review in the *Journal* (Winter 1968) who apparently did not find any merit in the book and dismissed it without any recommendation.

In the letters by Dr J. E. Leonard-Jones (p. 121, line 5, 1968) he says: "it would be interesting to know what caused a greatly increased incidence of Crohn's Ulcer in the last half of the century. His experts have been able to refute Peter Clowes's theory that the movement system, as the transmission of radial input in the cavity has had a significant effect on the incidence of Crohn's Ulcer." And as regards the statement (p. 121, line 26) that there is no evidence to prove that altering the patient's diet accelerates the rate of healing . . . etc. are the remarkable FGW's impression of Peter's brother, Ralph, and John Page and other ungrateful FGW medical officers recorded in Chapter IX in *Peter's Ulcer* (1962) to be merely ignored?

It is not the purpose of this letter to argue for or against the conception advanced by Peter Clowes but I find it hard to believe that the distinguished members of the Foreword and the co-authors, would go along in enthusiastically with him if his message is all nonsense. And if not, I should have thought it would be only fair to acknowledge the work of a great medical officer as a great medical symposium on

the particular subject. It might even be worth the while (as the several studies of horses in London showed) to do a simple and practical remedy. (Dr. Asper himself would be well to add that on the Science

From across a vast, wooded office, duty is looking the field against their supply of distant without any understanding of even to acknowledge it. From his own his own only "A. prophet, a man without human face, in his own country and in his own house."

Age Group	Percentage (%)
18-24	15
25-34	25
35-44	35
45-54	55
55-64	75
65-74	85
75+	88

**Figure 1**

Received 12 May 2006; accepted 12 July 2006

<sup>1</sup> The authors are grateful to the referees for their helpful comments.

**Table 1**

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The following is an extract from a letter by a General Issues Medical Officer writing on a file in a general issues letter to his superior for assistance:

I suppose it must also be right to wish us that I have really made a real difference. Humble GPs' efforts have been national. I hope that my good fortune, and the encouragement given by the Medical Director General in appointing a Medical Officer to assist the ministers of faith Medical Officers, will encourage more, more young men that there really is a fair wage in General Medicine, on the Royal Navy. For my own part I am now greatly glad that I opted out of Radiology even although I got some very bad advice at the time. Since then I have become the most successful man in Australia visited the USA and Canada, gained well-related in Australia since the job I love and have been paid as well. I am confident that these successful happy days, have no end as an opportunity.

The comments reported in this letter are well worthy of note by the mass, junior Naval Medical Officers, who may feel that it is warranted to a charitable extent to jump on the epidemic bandwagon. At least one Naval Medical Officer appreciates that there remains a very realifiable career as General Medicine in the Navy and who can doubt the accuracy of his comments on the recorded incident.

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## Reviews

2000, 1000, Brown on Monkeys 1989, Pp 488, Chicago, from World Medical Publishers, Inc. (Available in U.K. from John Wiley & Sons Ltd, Chichester, 112s)

It is, as it happens, one of the few books that is almost self-sufficient in the world because it will read as these valuable volumes in the various fields of medicine. However, it is not from the 1980s, it is a book of general interest to all who wish to read and the book is not too long to read.

The book is a very good book of general interest to all who wish to read and the book is not too long to read. The book is a very good book of general interest to all who wish to read and the book is not too long to read.

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J. M. C.

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Compute the above moments, then as a moment test I find that the two periods lengths are not equal, already just looking at small  $n$ -low (and) and at the right, as  $\hat{p}_1 = 0.0001$ ,  $\hat{p}_2 = 0.0001$ ,  $\hat{p}_3 = 0.0001$  and  $\hat{p}_4 = 0.0001$ .

Library of Theology, Department of Theology, University of Toronto, Toronto, ON M5S 1A5, Canada. E-mail: [theology@utoronto.ca](mailto:theology@utoronto.ca)

As in our first article, I suggest that the general medical system with a culture of blame is not a good one. I am not suggesting a return to an earlier medical culture. More appropriately the culture of blame should be replaced by a culture of responsibility.

as the solution of the following system of the  $(n-1)$  linear equations in  $n$  unknowns:

$$\sum_{j=1}^n a_{ij}x_j = b_i, \quad i = 1, 2, \dots, n-1, \quad (1)$$

where  $b_i = b_i - a_{in}x_n$ . It is convenient to turn the rectangular matrix  $A = (a_{ij})_{n-1, n}$  to the square matrix  $A' = (a'_{ij})_{n-1, n-1}$  by dropping the last column of  $A$ . Then the system (1) can be written in the form

$$\sum_{j=1}^{n-1} a'_{ij}x_j = b_i, \quad i = 1, 2, \dots, n-1, \quad (2)$$

where  $a'_{ij} = a_{ij}$ . The matrix  $A'$  is nonsingular, since  $A$  is nonsingular and  $x_n$  is arbitrary. Therefore, the system (2) has a unique solution  $x_1, x_2, \dots, x_{n-1}$ . Substituting these values into the last equation of the system (1) we obtain  $x_n$ . Thus, the system (1) has a unique solution  $x_1, x_2, \dots, x_n$ .

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the most important steps (personal and organizational) in the development of a successful communication system, as well as the role of the design team. The authors also discuss the role of the design team in the development of a communication system, and the role of the design team in the development of a communication system.

For binary random variables, the distances of values from 0 and 1 are  $d_0 = 1 - x$  and  $d_1 = x$ , respectively. Thus, given the following set of observations  $\{x_1, x_2, \dots, x_n\}$ , the distance of the mean from 0 and 1 is  $d_0 = 1 - \bar{x}$  and  $d_1 = \bar{x}$ , respectively. For a set of  $n$  observations, the distance of the mean from 0 and 1 is  $d_0 = 1 - \bar{x}$  and  $d_1 = \bar{x}$ , respectively. For a set of  $n$  observations, the distance of the mean from 0 and 1 is  $d_0 = 1 - \bar{x}$  and  $d_1 = \bar{x}$ , respectively.

As you can see, the *Artemis* mineral has a  $\text{Si}^{4+}$  cation from *orthosilicate*, or *silicate* (a  $\text{SiO}_4$  tetrahedron) and *oxide* (an  $\text{O}^{2-}$  anion).

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and the 1000th anniversary of the founding of the city of London, the 1000th anniversary of the founding of the city of London, the 1000th anniversary of the founding of the city of London.

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They are being collected in order to be collected: it is an end in of oneself purpose.

The membrane sealed the laboratory in the morning. It is not clear how and should not be destroyed (10) and should therefore be recognized as a useful and important, as a reference to a number of other references, especially those which are concerned with it - and of which it is possible to find a number of references in the literature. The fact that it is possible to find a number of references in the literature is not surprising, as it is a very common phenomenon.

Submitted: December 10, 2003; Accepted: February 10, 2004. Reprints: Dr. John D. Cullen, MD, PhD, Department of Pathology, University of Michigan, 1600 Hill Road, Ann Arbor, MI 48106-0610 (e-mail: jdcullen@umich.edu).

The authors of this book are, I think, largely self-interested, self-righteous, and somewhat opinionated. They are, however, very intelligent, and they have done a very good job of presenting the evidence in a clear and concise manner.

The literature was largely good with the point of view of the 20th-century perspective and the more modern long traditions. As noted in the past, the book is organized primarily for postgraduate students willing to learn advanced knowledge concerning their theories and on the modern and more recent past in natural phenomena and others. Based on the subject, this book is also applicable to both high school and college.

It is worth noting that it is extremely possible to cover all aspects of the educational system of general medicine and a fairly summary, in fact, that there are detailed reviews, not only on each of these subjects, but on each of the 14 sub-topics, and on each of the 14 sub-topics, in the following sub-sections. For the reasons and comments on the changes that will represent the future work in medicine, and the changes in the future of the future.

There is an 1800 ft long oriented borehole core and surface water and rainfall water at the end of the bore, and additional information can be found at the end of the bore.

The 1985 epidemic in Chile, in the system of the river Maipo, led to the isolation of several strains in the management of numerous salmon producers, or hatcheries, of a disease in the fish, long known as "red" or "brown" rot and referred to parasitic diseases, ulcers and necrosis (caused by the *Ichthyophthirius multifiliis* parasite) (1). After that there was no record in the fish or other aquatic organisms in the lake. This disease is characterized by the existence of necrotic spots that spread in a few days (caused by a *Microsporidium*, *Microsporidium* and *Microsporidium*, both, which has long been reported in wild fish, mainly in salmonids in the Pacific Ocean).

Minneapolis: Eastern Marine Supply (Ocean Group, Inc.) Book Store; Fisheries  
 Commission of U.S. Navy, 1969. 100 pp. 100 illustrations. \$1.50.

The main criticism of this study was published in early 2004 by a distinguished biologist. The central criticism regarding the statistical interpretation remained as it always perhaps may be, with the limitations and assumptions of statistical analysis.

[illegible]

This book is a comprehensive reference book on epidemiology available to such as N. or D. or to those who require this information. But the literature is the natural habitat of the researcher, and epidemiology itself is not science and even philosophy (not to say social science) by all standards, including a few scientists.

<sup>1</sup> This is a feature of the standard for the *Micrographia* project, and is not a feature of the standard itself. See <http://www.mikropix.org/>.

From *Home in Language* (1992), edited by John Frow, Paul and Barbara Atkinson, Pp. 141.  
(Chicago: The Book World Publishers, Circulation in UK from John Wiley & Sons Ltd, Chichester, 1993)

The 1991 Year Book contains a collection of abstracts of some 600 papers. It covers a very broad range of subjects closely related to both design and ergonomics and the Department is now responsible for this.







*Twentieth-Century Literature*, edited by Arnold Bennett (New York: Oxford University Press, 1964), pp. 320, \$12.50.

Great again! This is a book that has, indeed, made a difference. It is a book that has, indeed, made a difference.

It is a book that has, indeed, made a difference. It is a book that has, indeed, made a difference.

*Twentieth-Century Literature*, edited by Arnold Bennett (New York: Oxford University Press, 1964), pp. 320, \$12.50.

It is a book that has, indeed, made a difference. It is a book that has, indeed, made a difference.

P. H. G. 7

[illegible]

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<sup>1</sup> We report to summarize the study of the paper, Chomsky (1975, 1976, 1977, 1978, 1979, 1980, 1981, 1982, 1983, 1984, 1985, 1986, 1987, 1988, 1989, 1990, 1991, 1992, 1993, 1994, 1995, 1996, 1997, 1998, 1999, 2000, 2001, 2002, 2003, 2004, 2005, 2006, 2007, 2008, 2009, 2010, 2011, 2012, 2013, 2014, 2015, 2016, 2017, 2018, 2019, 2020, 2021, 2022, 2023, 2024, 2025, 2026, 2027, 2028, 2029, 2030, 2031, 2032, 2033, 2034, 2035, 2036, 2037, 2038, 2039, 2040, 2041, 2042, 2043, 2044, 2045, 2046, 2047, 2048, 2049, 2050, 2051, 2052, 2053, 2054, 2055, 2056, 2057, 2058, 2059, 2060, 2061, 2062, 2063, 2064, 2065, 2066, 2067, 2068, 2069, 2070, 2071, 2072, 2073, 2074, 2075, 2076, 2077, 2078, 2079, 2080, 2081, 2082, 2083, 2084, 2085, 2086, 2087, 2088, 2089, 2090, 2091, 2092, 2093, 2094, 2095, 2096, 2097, 2098, 2099, 2100, 2101, 2102, 2103, 2104, 2105, 2106, 2107, 2108, 2109, 2110, 2111, 2112, 2113, 2114, 2115, 2116, 2117, 2118, 2119, 2120, 2121, 2122, 2123, 2124, 2125, 2126, 2127, 2128, 2129, 2130, 2131, 2132, 2133, 2134, 2135, 2136, 2137, 2138, 2139, 2140, 2141, 2142, 2143, 2144, 2145, 2146, 2147, 2148, 2149, 2150, 2151, 2152, 2153, 2154, 2155, 2156, 2157, 2158, 2159, 2160, 2161, 2162, 2163, 2164, 2165, 2166, 2167, 2168, 2169, 2170, 2171, 2172, 2173, 2174, 2175, 2176, 2177, 2178, 2179, 2180, 2181, 2182, 2183, 2184, 2185, 2186, 2187, 2188, 2189, 2190, 2191, 2192, 2193, 2194, 2195, 2196, 2197, 2198, 2199, 2200, 2201, 2202, 2203, 2204, 2205, 2206, 2207, 2208, 2209, 2210, 2211, 2212, 2213, 2214, 2215, 2216, 2217, 2218, 2219, 2220, 2221, 2222, 2223, 2224, 2225, 2226, 2227, 2228, 2229, 2230, 2231, 2232, 2233, 2234, 2235, 2236, 2237, 2238, 2239, 2240, 2241, 2242, 2243, 2244, 2245, 2246, 2247, 2248, 2249, 2250, 2251, 2252, 2253, 2254, 2255, 2256, 2257, 2258, 2259, 2260, 2261, 2262, 2263, 2264, 2265, 2266, 2267, 2268, 2269, 2270, 2271, 2272, 2273, 2274, 2275, 2276, 2277, 2278, 2279, 2280, 2281, 2282, 2283, 2284, 2285, 2286, 2287, 2288, 2289, 2290, 2291, 2292, 2293, 2294, 2295, 2296, 2297, 2298, 2299, 2300, 2301, 2302, 2303, 2304, 2305, 2306, 2307, 2308, 2309, 2310, 2311, 2312, 2313, 2314, 2315, 2316, 2317, 2318, 2319, 2320, 2321, 2322, 2323, 2324, 2325, 2326, 2327, 2328, 2329, 2330, 2331, 2332, 2333, 2334, 2335, 2336, 2337, 2338, 2339, 2340, 2341, 2342, 2343, 2344, 2345, 2346, 2347, 2348, 2349, 2350, 2351, 2352, 2353, 2354, 2355, 2356, 2357, 2358, 2359, 2360, 2361, 2362, 2363, 2364, 2365, 2366, 2367, 2368, 2369, 2370, 2371, 2372, 2373, 2374, 2375, 2376, 2377, 2378, 2379, 2380, 2381, 2382, 2383, 2384, 2385, 2386, 2387, 2388, 2389, 2390, 2391, 2392, 2393, 2394, 2395, 2396, 2397, 2398, 2399, 2400, 2401, 2402, 2403, 2404, 2405, 2406, 2407, 2408, 2409, 2410, 2411, 2412, 2413, 2414, 2415, 2416, 2417, 2418, 2419, 2420, 2421, 2422, 2423, 2424, 2425, 2426, 2427, 2428, 2429, 2430, 2431, 2432, 2433, 2434, 2435, 2436, 2437, 2438, 2439, 2440, 2441, 2442, 2443, 2444, 2445, 2446, 2447, 2448, 2449, 2450, 2451, 2452, 2453, 2454, 2455, 2456, 2457, 2458, 2459, 2460, 2461, 2462, 2463, 2464, 2465, 2466, 2467, 2468, 2469, 2470, 2471, 2472, 2473, 2474, 2475, 2476, 2477, 2478, 2479, 2480, 2481, 2482, 2483, 2484, 2485, 2486, 2487, 2488, 2489, 2490, 2491, 2492, 2493, 2494, 2495, 2496, 2497, 2498, 2499, 2500, 2501, 2502, 2503, 2504, 2505, 2506, 2507, 2508, 2509, 2510, 2511, 2512, 2513, 2514, 2515, 2516, 2517, 2518, 2519, 2520, 2521, 2522, 2523, 2524, 2525, 2526, 2527, 2528, 2529, 2530, 2531, 2532, 2533, 2534, 2535, 2536, 2537, 2538, 2539, 2540, 2541, 2542, 2543, 2544, 2545, 2546, 2547, 2548, 2549, 2550, 2551, 2552, 2553, 2554, 2555, 2556, 2557, 2558, 2559, 2560, 2561, 2562, 2563, 2564, 2565, 2566, 2567, 2568, 2569, 2570, 2571, 2572, 2573, 2574, 2575, 2576, 2577, 2578, 2579, 2580, 2581, 2582, 2583, 2584, 2585, 2586, 2587, 2588, 2589, 2590, 2591, 2592, 2593, 2594, 2595, 2596, 2597, 2598, 2599, 2600, 2601, 2602, 2603, 2604, 2605, 2606, 2607, 2608, 2609, 2610, 2611, 2612, 2613, 2614, 2615, 2616, 2617, 2618, 2619, 2620, 2621, 2622, 2623, 2624, 2625, 2626, 2627, 2628, 2629, 2630, 2631, 2632, 2633, 2634, 2635, 2636, 2637, 2638, 2639, 2640, 2641, 2642, 2643, 2644, 2645, 2646, 2647, 2648, 2649, 2650, 2651, 2652, 2653,

Nathan Greenbaum's father joined the Royal Naval Medical Service in December 1873. He was promoted to Surgeon Lieutenant-Commander in September 1892 and to Surgeon-Captain in December 1911. He was killed on the Gallipoli in his last command on December 22, 1915.

[illegible]

Downloaded At: 11:53 11 September 2009

Keyes (Arthur) died as a result of injuries sustained in a fall from a ladder while working on the roof of the building. The cause of death was listed as a heart attack.

The police have been a challenge for the local population. They just have been too afraid to leave their homes and go to work. The situation is a little better but we still have some things that need improvement, like electricity, health, and other things that are very important. We had a lot of people, about 100,000, who were afraid to go to work. We had a lot of people who were afraid to go to work. We had a lot of people who were afraid to go to work.

After therapy, subjects received the final assigned 24 sessions approximately 10 to 12 months later. In the final assessment, 14 of the 24 subjects in the control group had been dropped out of the study. Of the 10 subjects that remained, 5 had been dropped out of the study because they had dropped out of the study before the final assessment. The 5 subjects that remained in the study were dropped out of the study because they had dropped out of the study before the final assessment.

From Linda Rogers very soon after I joined the Service, all subsequently named the company and funds which were made up of the profits. I had a share in the company from 1966 to 1969. Since

[illegible]

The *Alouatta* is a highly expressive of the genus for making and hearing sounds, as evident comparing the monkey the ability to keep its mouth, tongue and throat and produce frequently. It was observed to have the ability to be the other such lower and lower-level animals.

Revised Catalog: 101 William Edward Lohm, PH.D. 1964, 1974, 1984, and 1994  
 by: 1974, 1984, and 1994

Bayonet Company (26 Bayonet column) the Royal Navy as Sergeant Landrums (26) and was appointed as BN Sergeant. On 14 January 14 1917, after serving of six years on the Crimean front, he was promoted Sergeant Landrums Company (26) on September 1, 1917. In the summer of 1917 of the Russian Civil War he participated in it as a bayonet Commander (26) in which rank he was discharged on December 10, 1918.

After that year, he held a number of appointments, as New Hampshire he became and continued to be appointed as young men's lives. Later, as it seems unlikely, he worked as 1846. From the autumn of 1846, he was again in the service of the state, but was transferred to the Department of the Interior in 1848. He was placed on the list of the 1848-49 New Hampshire Department, on April 15, 1849.

Received December 1, 1991; accepted February 1, 1992.

Stephen Curran (E) also joined the Royal Navy as a Surgeon-Lieutenant (E) on January 2 1817, was promoted to Surgeon-Lieutenant-Commander (E) on January 7 1820, and to Surgeon-Commander (E) on January 1, 1823. From the same office he was promoted to Surgeon-Lieutenant-Commander (E) on January 1, 1826.

Sergeant Corporal Robert Percy WILLIAMS MB CMR MRCGP RN died on January 11 1918 at the age of 40.

Sergeant Commander Williams graduated from Aberdeen University MB CMR in 1914 and joined the Royal Navy as a young Surgeon Lieutenant on May 7 1915. He was promoted to Surgeon Lieutenant Commander on February 7 1916 and to Surgeon Commander on December 14 1916.

#### B. M. notes

The integrity and exact style of Robert Williams added the touch of one of the most powerful characters and his family and friends of a very noble person. He was intensely, deeply both in character and in his personal organization. He was devoted to patients and staff alike. He was given out in his own and others' interests, more based on personalizing things up of his patients and organizing clinical teaching and research. He had more usually shown interest in clinical research for which he had founded research staff groups.

As an individual he had a depth of compassion and accepted his great responsibility with a generous strength. He will always be remembered with affection as a friend and colleague. The sympathy of all who knew him will go to his wife Sylvia and to his four children who shared in his devotion to his always a man as a man and as a doctor.

#### J. B. L. G. notes

Robert was a very special person. His extraordinarily friendly approach made him a naturally sympathetic and trusted doctor and his confidence in his knowledge and of his own—the way undoubtedly through the best means I have ever met—and certainly the human—created a sense of peace.

Robert must have been one of the most powerful young medical officers in the Royal Navy for he was more than just a doctor. He was a physician and generous of mind and nobility of character (as we know when the gods speak).

In his wife Sylvia and in his four children we see in a deeper sympathy.

### PROFESSION AND ACADEMY

New York Museum—1978

#### Committee of the Order of the British Empire

Surgeon Captain G. B. M. MRCGP MB CMR FRCR (S) L.D.S. 1915

#### Office of the Order of the British Empire

Surgeon Commander M. J. MRCGP MB CMR FRCR (S) 1915

#### Queen's Honorary Surgeon

Surgeon Captain J. W. MRCGP MB CMR

Surgeon Captain G. B. MRCGP

#### Queen's Honorary Physician

Surgeon Captain P. B. MRCGP MB CMR

Surgeon Captain G. B. MRCGP

### PROFESSIONAL QUALIFICATIONS

Surgeon Captain G. B. MRCGP MB CMR FRCR (S)

Surgeon Commander G. B. MRCGP MB CMR FRCR (S)

Surgeon Commander G. B. MRCGP MB CMR FRCR (S)

Surgeon Commander G. B. MRCGP MB CMR FRCR (S)

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Surgeon Commander G. B. MRCGP MB CMR FRCR (S)

Surgeon Commander G. B. MRCGP MB CMR FRCR (S)



*News of the Service*

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*Announcements*

Miss M. A. Pollockson, Father: OBE, R.N.C.—Matrons on Coast

Miss A. M. Gould, R.N.C.—Principal Matron

Miss M. B. Trench—Superintendent Nurse

**ROYAL NICKEL RESERVE**

**Quebec Honorary Surgeon**

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*Commissary*

Cdr. Surgeon-Lieutenant-Commander J. D. C. Hay, M. B. Sc.D.

Cdr. Surgeon-Lieutenant-Commander (SB) R. H. Boyd, OBE, M. A. Public.

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Surgeon-Captain J. G. A. Pope, V.R.D.

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Surgeon-Lieutenant-Commander C. E. Maloney

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The syndicate in Kingston, Comprising J. W. Moffat for carrying two OBE and two Commis-  
sary pages of the 10 July 1944 issue of the Journal



# Journal

of the

## Royal Naval Medical Service

*(The Editors of *Journal* do not accept responsibility for the opinions expressed in this Journal.)*

*For names: The Medical Director-General (Naval) and the Master of the Journal*

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100

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Royal Navy Medical Club House 1970. Specializing in Medical Research  
General (Navy) and the Second Sea Lord

100

**Cyanoacrylates:** *Quinn* : *Bartlett* : *Hawkins* : 1979 *Quinn* : *Ministry Physicians*  
*Quinn* : *Ministry Surgeons* *Quinn* : *Ministry Dental Surgeons*  
**Higher Qualifications:** *Forman* : *Provincial* : *Education* : for  
 promotion to date December 31, 1979 *New Entries* : *Transferred*  
 to the Permanent List *Referrals* : *Short Service Commission*  
*Referrals* : *Workingmen Officers* : *Quinn* : *Alexandre* : *Royal Naval*  
*Medical Service* : *Royal Naval Reserve* : *Civilian Commission* :  
 to the Royal Navy : *Fellows of the Institute of Medical Laboratory*  
*Technicians* : *1979*



**Figure 1**

**Keywords:** *workplace spirituality; organizational commitment; employee engagement*

**Figure 1**

St. Louis Blue Avenue, East Ward, was an early Day of Naval Medicine

BRUNNEN CARLTON L. C. THOMAS, JR., on the reciprocal relationship between  
of Naval Medicine

BRUNNEN CURTAIN (C) F. L. HARRIS AND SON, INC. (ING) DIVISION OF BRUNNEN  
GARDEN AND BARNARD

Reigada Gonzalez P. C. (current address) was Professor of Naval Surgery  
Mar José Barja de Haza, Editorial Director





The Master of Gunboat, Comdr. J. J. Smith, presenting the "Michael Brown Medal" to the  
 Surgeon Vice Admiral C. B. Smith, U.S. Navy, with the medals containing the Division credit.

Photography courtesy of The Navy Personnel

## Editorial

The Royal Naval Medical Service was awarded a special mention on Friday September 11, 1915 when such traditional pageantry...it awarded the Freedom of the Borough of Gosport. This was primarily an acknowledgment by the Borough of the increasing influence of the Royal Naval Medical Service upon the lives of its citizens and of the standards of practice that they had found its appointment in the Royal Naval Hospital, Haslar. The Service maintains at a high sense of duty combined with genuine concern for the individual is responsible for the standing which naval hospitals today enjoy and at a time when criticism is frequently made of a decline in such standards on a national scale. Additionally the service naval medical operations provide both clinical and technical services for the Western Empire and elsewhere.

However, in conferring its Freedom upon the Royal Naval Medical Service rather than local institutions the Borough was mainly acknowledging its debt to a much larger number of medical, dental and nursing staff who, without particular local ties, use that comparatively brief period of naval service within the boundaries of the Borough to build as well. Working together in the quiet anonymity which is characteristic of the Service they are slowly deporal, at the bottom of an unending opposition to some new and challenging responsibility, often in an unfamiliar environment where a unique emergency demands and usually obtains the medical skills and specialized knowledge it has come to expect from the Medical Service of the Royal Navy.

The closest fellowship and varied talents of medical and dental officers are exemplified by the stirring Freedom March composed by Surgeon-Commander F. M. Munster for the occasion. It is hoped that a fragment of this will be reproduced together with discussions of the Freedom scroll and enter an association with its article on the ceremony which Surgeon-Captain Pugh has kindly undertaken to write for the Spring 1971 issue of the Journal.

The number of the Journal also records the death of a contributor, Surgeon-Captain Harold Hinkson, whose obituary appears on page 203. The passing of one of today's elite is lamented and interpreted in 1971 generations of a century ago which produced such practitioners as Richardson, Stanley and Hooker. But he appears more reluctant to share his experience. The editorial committee wishes him to do so through the pages of the Journal.

## THE BIOLOGY OF THE ATOPIC RESPONSE\*

By Peter J. Fenton

In 1913 Arthur E. Huxley (Cox), whose name is closely associated with the atopic syndrome, founded the *American Journal of Allergy*; partly because his own writings on the subject were so often rejected by the editors of other periodicals as being too thetic. In this venture, he required some financial support. This he received. Dr. Theobald Smith is reported to have accepted a test on the Editorial board. In a letter of acceptance Smith remarked, "immunology is dead" (Cox, 1944). In other words those venturing to write on immunological subjects in 1913 might be pardoned for thinking that Theobald Smith had been right, for the literature is formidable. It is only the numerous atopic patients, within the Royal Navy, of training war units land against the background of varying parts of the world and varying indigenous peoples that has persuaded a Service general physician to venture into this particular field.

To begin on common ground—a preliminary discussion of the atopic state in man may be put as follows:—

The atopic state in man is the typical situation in which certain individuals react, hyper-sensitively to an antigen stimulus in such a way as to stimulate the formation of antibodies which may have two characteristics of extreme significance.

In this special situation there are two aspects of immediate concern. Firstly, there is the immune mechanism itself, and secondly the end-organ responses that result in the disease processes we recognize at the bed side. In the argument that follows it helps to keep these two aspects of one disease-producing process separate in one's mind.

Since the immune mechanism initiates the disease process, it seems reasonable to consider this basic immune mechanism first from an evolutionary point of view and to embark on the subject in a traditional biological manner.

In the evolutionary sense, responses of immunologically active substances lead to a cellular phagocytic reaction within the organism itself. Phagocytosis apparently occurs the foreign particles and ultimately tissues (Clood and Papanicolaou, 1944). The most primitive immunological mechanism which isolates components of the external particle as being foreign to the host, is therefore, a cellular reaction. It has proved over the type to be a highly efficient mechanism even though it permits relatively easy homologizing between members of the same species. It is however still a very adaptable mechanism, for the response to all that is foreign is uncompromisingly the same. It is only at the vertebrate level of the evolutionary tree in which adaptive immunity appears (Barnet, 1944).

At the lower level of the vertebrate tree lies the vaccination, *lymphocyte*

\*Topic read at Symposium on Allergy held in the Royal Naval Hospital, Haslemere on March 17, 1958.

species, our fortune by some 400 million years. Its failure to prey on dead or dying fish in whose bodies it has having entered by natural or traumatic wounds. Living within the decomposing bodies of dead hosts, they find both nourishment and protection in the sea bottom. It is hardly surprising perhaps that the ingestion of foreign proteins or other antigenic particles into the hag-fish causes only a cellular response similar to that seen in the mussel. All attempts to induce the production of circulating antibodies, with or without the use of adjuvants, have failed. Antigens can, in fact, be stored in hag-fish bags in buckets of sea water (Papernoster, Conda and Gould 1962).

One more up the evolutionary tree to the more familiar lamprey (*Petromyzon* spp.) reveals a very different situation. The lamprey possesses an epithelial thymus with occasional lymphoid cells and small foci of lymphocytes in a primitive spleen; neither in form nor in the hapfish, this is associated with a marked change in immune logical capacity. Associated with these morphological developments is the ability to produce circulating antibodies and bodies on challenge. With this change comes the rejection of histografts, though autografts are accepted (Gould and Fordall 1964).

How this change in the pattern of immune reaction occurred is not clear, but with it came the ability to make adaptive changes in varying environmental conditions. Immune stimuli. Evolutionary theory demands some raw material from which to develop such new functional systems and it therefore seems that from the vertebrate lamprey was evolved the specific cellular system that characterizes homo-graph immunity and delayed hypersensitivity and therefore it is probably from this more primitive vertebrate endothelial cell stem that the adaptive humoral system, the gamma globulins of mammals and man, evolved at a much later date.

The ability to produce circulating anti bodies is regarded as primitive fishes being more readily produced in sea animals the evolutionary tree, apparently as parallel with the more advanced fishes production for warmer waters, still is necessary, as in birds one finds both thymus dependent immunological responses, of cellular type and humoral mechanisms depending upon gut associated lymphoid tissue.

Discarding the steps, cytotoxic in man we must estimate the humoral system which produces the gamma globulins known as IgA, IgD, IgM and particularly B-globin, which has been designated IgG.

IgG is, as it were, the marker of the mechanism whereby type I immune hypersensitive reactions. In essence IgG is produced in response to the entry of various antigens at or from or by ingestion. The antibody IgG reaction binds to the surface of the mast cell which requires to most areas of the body. It is only the spread of further covalence or local antigen that reacts with the IgG on the surface of the mast cell substance enzymatic changes within the cell and among the release of pharmacologically locally active substances including Histamine, 5-Hydroxytryptamine and Serotonin substance A (Stallworth, 1966).

It is these active substances locally in the skin, nose and bronchial mucosa that initiate the end organ response we recognize as allergic disease.

Having considered the mechanism and the reaction, we have arrived at the end organ response which deserves consideration on its own right, for what caused Con-

and Cooke in 1919 to separate those suffering from the atopic syndrome from those suffering any other anaphylactoid type I reaction were the following features —

(1) The special nature of the end-organ response

- (a) its occurrence not in the population as a whole but only in a special group of that population

For this special response in a minority of the population, they coined the word *atopy* derived from the Greek *Atopia*. This was suggested by Professor E. D. Ferry of Columbia University, for as a biologist had a particular application to medicine, meaning 'anomalous' or 'incongruous', particularly with regard to the effluents (symptoms) of disease. In a somewhat derogatory addendum to the same paper Cooke pointed out that atopy 'develops naturally in man as a result of inherited factors', adding 'The atopic man is qualitatively unlike the normal man'.

Subsequently, in 1925, Cooke expanded the definition in the following manner —

...typical hypersensitiveness peculiar to man, subject to hereditary influence, producing chronic lesions affecting eyes, nostrils, ear, or respiratory organs and producing periodic allergic conditions such as urticaria and hay fever (Cooke and Cooke, 1925).

Even this definition must now be modified since under certain circumstances the atopic response can occur in other animals such as the North Western University colony of atopic dogs who have been shown to form IgE (Pfeleberg, Chang and Furstovsky, 1963).

Previously the presence of atopy, or IgE, was only demonstrable by the Praeger-Kuttner reaction requiring the consideration of groups from one individual and the skin of another, which is not without hazard, but in recent years sophisticated techniques, particularly in the hands of Johansson in Uppsala, have made it possible to measure IgE levels in the blood. These measurements were announced at the reports of the Institute of Clinical Immunology meeting at the Royal Society of Medicine in September, 1969. From this data it is clear that in Scandinavia atopic subjects are good IgE producers compared to the general population:

IgE levels	
Scandinavian: Normals	200 µg/l
- Asthmatics (allergic)	all normal level
- Hay fever patients	all 3 " "
- Atopic dermatitis	all 6 " "

(after S. G. O. Johansson, 1969)

The question therefore arises as to whether atopic individuals inherit this special ability to IgE produce, for it must certainly be special in the sense that it is not general in the population as a whole, affecting between 10 and 12 per cent in the more sophisticated Western world.

In general there is a strong impression that there is a hereditary influence of atopy and many accept Scheppler's population survey in Zurich, studied from the genetic point of view as representative (Scheppler, 1968), his conclusion being that, with some considerable overlap between the two disciplines, atopy is inherited as a single autosomal dominant gene with reduced and perhaps variable penetrance. Certainly

the exact mechanism of inheritance is still open to some argument. One argument against a recessive mechanism is the fact that non-allergic children are born of parents who are both allergic and a number of recent studies suggest dominance in that atopic descendants are born of non atopic parents (Kajita and Renner, 1969). Possibly the most significant point is that Schepeler did show, in the paper referred to above, 100 per cent concordance for atopic disease in his series of 12 pairs of her selected monozygotic twins suffering from the disorder.

When one comes to consider the end-organ response in the atopic individual other factors are apt to confuse the clinical picture. Various factors become altered by environmental change throughout while emotional factors play an often subtle, yet very part and visible factor, under the skin type reaction in man. Atopic rhinitis tends to be the most clear cut clinical entity of the three as well as being the commonest atopic manifestation occurring alone. Schepeler records in his survey the incidence of the three forms of disease as follows:

Rhinitis,	62.8%
Asthma	32.4%
Eczema	19.5%
Asthma and Rhinitis	16.6%
Eczema and Asthma	9.3%
Eczema, Asthma and Rhinitis	9.3%
Eczema and Rhinitis	9.8% (100 families)

Because it is the most clear cut clinical entity, atopic rhinitis will be used as the end organ response indicator of the atopic reaction for the remainder of the discussion.

As the atopic response affects a special 10 per cent of the general population in the Western world and is only rarely seen in the more under-developed areas. There is a difference in incidence between various population groups. In the areas of highest incidence the disorder, for which there is considerable evidence to suggest a genetic background, is maintained at a level of 10 per cent in the population. This situation is strongly suggestive of a balanced polymorphism, in which the high proportion of those affected is perpetuated as a result of some associated biological advantage. A 10 per cent incidence is far too great to be explained on the basis of pure mutation alone.

It is intriguing to Allison's demonstration of the maintenance of haemoglobin *S* trait in 1 per cent of the population in an area of Africa where malignant malaria was endemic and where the haemoglobin *S* carrying red cells being resistant to the malignant malarial parasite, endowed the possessor of the haemoglobin *S* trait with a distinct biological advantage over the normal individual who was more subject to infection and liable to a greater mortality when infected (Allison, 1959).

Robertson has shown the high level of IgE production in atopic subjects and he has also demonstrated that unselected Ethiopian children have serum levels of IgE 10-20 times greater than healthy Swedish children. In Ethiopia however the atopic

syndrome virtually does not exist. Secondly, he has shown that Enterogut atrophy with steatorrhea here thirty years ago involving IgE of English children (Johansson, 1964).

On the surface therefore the IgE production system might be playing some part not only in the atopic syndrome but also in the response of the human host to nematode parasites. In my opinion, based on experience in the Mediterranean, Capton and Far East, many diseases tend to disappear in English people abroad and vice versa in the indigenous populations. In both European and local populations worm infestations, particularly with numerous co-infections,

Could it then be that the biological advantage associated with an efficient IgE producing mechanism is related to the maintenance of the balance between host and parasite in worm infested systems. The human system thus becomes parasite 'under natural biological conditions'? And further, could it be that where this mechanism is not at least somewhat well being in sophisticated hygiene surroundings, such as Western cities, where worm infestation is rare, the mechanism is aroused and becomes available to respond to less significant antigenic stimuli such as pollen? If this were true, then the maintenance of atopy such as hay fever would have appeared as grass was not only after standards of hygiene and sewage disposal had been raised to high levels.

To examine this aspect I have sought the earliest descriptions of hayfever in England. Amongst the scores of observers in town and country, one can find no reference to a postulated seasonal change in duration or the works of Thomas Blizard. Even in medical literature it was not until 1819 that John Bowdich described his own hay fever (Bowdich, 1819) and subsequently in 1823 a further 21 cases of what he called Catarrhus nasae, drew attention to my (pretypical and atypical) nasal and it has mentioned a possible role for pollen. He also pointed out its occurrence only in those of the upper social strata, amongst whom he included 'servant officers' (Bowdich, 1823). Blackley, writing later in 1873 on Catarrhus nasae, commented: 'it is probable that it was not only rare but that it was, in early times, almost if not entirely unknown' (Blackley, 1873).

The disorder, my fever, seems therefore to have appeared in England amongst the upper social classes in about the time of George IV, when aristocratic living conditions had become more hygienic and just before the time when such episodes as the Broad Street Pump-cholera outbreak (1854) drew the attention of the privileged to the poor hygienic conditions in English cities, which resulted in the 1854 Commission to report into the overcrowding in London and ultimately to the Housing of the Working Classes Act of 1890. It is salutary to note that it was not until 1873 when the great northern rail fall tower was built along the north bank of the Thames that there was any mass excretion of sewage disposal in Westminster other than down the large cess or tidal river. Certainly it seems that atopy, rhinitis dates from the time when hygienic disposal of sewage, with freedom from infection, with some structural re-arranges, became a feature of English life.

The question therefore arises as to whether there is any evidence to suggest that nematode infestation outside upon the atopic diseases, other than the fact that the syndrome is very rare in those parts of the world where worm infestation is rare?

12 Officers with *Hay Fever* following various schedules

4 days of hay fever for 3 years (80%)	
3 " " " 2 years (85%)	
4 " " " 1 year (95%)	
1 patient lost contact	(5%)

All remained asymptomatic in the environment in which previous hay-fever had been regular and recurrent.

Amongst a large series of patients with *asthma*, I have data on 12 naval officers serving at what was then called the Admiralty, working on one or other side of St James' Park. All had suffered from hay fever for some years, had previous chest tests to lung and pleural test pollen and were afflicted with the disorder at work in London when the trees in the nearby park were in pollen.

The 12 patients developed *asthma* during holidays or were on duty abroad and the diagnosis was made by demonstrating the test of *A. hirsutioides* in sputa obtained at remote exposures. The Table shows their period of freedom from hay-fever following the development of their *asthma* with other *asthma* individuals in the same manner determined in other studies. It is therefore suggested that the conditions in real situations took priority, at least as far as the immune mechanism underlying the *asthma* response was concerned.

There is evidence in the natural world that such a priority would be a biological advantage. For it is an extremely type I hypersensitivity response that restricts the interaction of young birds with the immature *Trichostema* by constrains its spontaneous (Barnett, 1945) and sustains the intensity of the passive information that would otherwise destroy the host birds and ultimately which leads to a state of balance between parasite and host which eventually results in self-cure in the birds given to right life (Sawyer, 1935).

The question of hy-pothesis involved in the *asthma* syndrome is a consequence of good hygiene? Certainly it is commonest in North America, England, Switzerland and Scandinavia. Should this hypothesis be an immunologic apology for an ordering under the wing of no less an immunologist than Sir Peter Medawar who at his Essay on Hypothesis and Immunity quotes Chittick forward a *hypothesis* in the Study of Medicine. An hypothesis is the obligatory starting point of all experimental reasoning. (Medawar, 1959).

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## RECRUITMENT FOR THE MILITARY

by Geoffrey G. Smith

### SUMMARY

Having reviewed some methods of military selection, their possible difficulties and ways of measuring their results, such as wastage rates and military effectiveness, this paper demonstrates limitations in the predictive value of cognitive ability and the need to consider other personally variable and foreign to the life history. United States Navy studies on marginal recruits and high school children have led to the abandonment of criminal histories as predictors of success. The Royal Naval recruiting procedure, although adaptable to national circumstances, contrasts with a system for restricted selection which is being initiated in the British Army and has many parallels. The author suggests that future research should include the selective power of motivation, rate and loss statistics, personal stress, sleep-deprivation testing, potential antisocial behaviour and short polyadic profiles.

### Galton

The military can claim to have been the first to use selection tests, for Galton conducted 'under stress' problems a two-stage procedure to choose an army of footmen for a battle against the Miskinites (Jagjag). He first screened for sanity and motivation by excluding anyone who admitted that their voluntary 31,000 conscription to 10,000. He then took those 10,000 to the river's edge and observed how they drank: accepting only 300 who lapped like a dog.

The footmen won the battle by psychological warfare. Galton overstepped while one of the enemy rolled a dozen and another misstepped at and, guided by the intelligence, he deployed the 300 in the middle watch outside the Miskinites' camp, where they broke pickets to reveal hidden traps, blew trumpets and shouted announcements to the Lord and Galton. The foot lost and died and fled.

### Difficulties peculiar to the Military

Galton's selection test was relatively easy because not only did he want men for a specific task, but also the Lord. For instance, knowing it would be unusual, would attract a technically unsuitable candidate for stage two of the selection process. Recruits on the other hand, require selection for an entire polysynoptic career, which a physician might describe as a closed system (Flynn 1953) and in which we have to find employment for everybody selected, offering the best possible compromise between the aptitudes of individuals and the widely varying needs of the Service.

### Selection versus Selection Methods

Flynn (1953) explains that there are two broad groups of selection tests 'Intelligence', which was measurements of ability, character traits and competencies,

and 'failures' depending on a general impression of the candidate's total personality. Holstein methods rely on outside referees' test and include devices such as watching a man's behaviour in the bath, or extremely strong electric currents through himself, the leader has put on a strip of Kleenex, groups and stress interviews. The Germans favoured these procedures and they were incorporated into the batteries of the War Office Selection Boards in the U.K. and of selection for the Office of Strategic Services in the U.S.A. They are unreliable because their objectivity is in question and the OSS staff ultimately found that school records and objective economic tests were better predictors than projection tests and interviews, which however are still in use in Britain (and many other selection boards).

#### Wastage rates

Previous studies exist for both economic and scientific careers, but the subject of any method of selection that is too serious for this follow up is not easy. Psychiatrists are naturally concerned with the wastage rate, particularly because Ellis (1956) has shown that emotional and attitudinal factors have become the commonest areas of weakness from the Royal Navy and because psychological factors clearly contribute to many accidents, notably those on the roads. However, wastage accounts for no more than a small part of the total wastage, so as the Americans call it, attrition, which is obviously probably a better criterion. Moreover, Barry (1964a) points out that there is evidence of premature discharge as an inadequate criterion and (1964b) that we ought to think in terms of an individual's military effectiveness rather than wastage or diagnostic categories such as psychiatric illness, personality disorder and dissatisfaction as an otherwise healthy person. Waxman (1962) goes further and thinks that the most reliable index of wastage may be the efficiency with which the Army fulfils its assigned role.

Newcastle team of wastage are excited by manpower considerations. Owen (1965) & Connor (1966) reported that for the Royal Air Force the total wastage rate between 1942 and 1946 was 4 per cent to 5 per cent per annum, of which ill-involvement accounted for 3 per cent to 5 per cent and psychiatric wastage for 0.5 per cent to 1 per cent. Waxman (1962) showed that in the British Army the premature discharge rate rose fairly steadily from 3 per cent in 1954 to 7 per cent in 1958. United States statistics are difficult to compare with British ones owing to interpretation (the draft) and the relatively late age of entry in the U.S. Services, but Wilson (1956) estimates that when corrections are made for these factors the wastage rate is similar on both sides of the Atlantic. Figures 1 and 2 illustrate comparable figures for the Royal Navy and Royal Marines. The R.M. graph shows that fluctuations in the total wastage curve are determined almost entirely by non-medical discharges and that these additivity to wastage is somewhat unexpected, which indicates that there are ways of having the Service use its own talent more intelligently. The sharp climb in the non-medical figures in 1967 and 1968 is caused mainly by the introduction of provisions for new entrants to help their discharge. Wastage in the first year of service rose from 7 per cent of the total entry in 1964 to 11 per cent in 1966 and 27 per cent in 1967 and has now reached the alarming figure of about 50 per cent.

The Boardman Committee is now investigating the human resources of the length



Fig. 1. Change of R.N. Ratings 1953 to 1963.



Fig. 2. Change of R.N. Rating Bands 1953 to 1963.

of career opportunities and the possibility of optional discharge. The Committee is likely to report soon and to recommend changes which could have profound effects on manning. To keep it in a measure good personnel policy and training and provision of social services in their widest sense will be essential.

#### Cognitive Ability as a Predictor

Those considerations which put the young man's psychology in perspective emphasize the need for selection. In that process intelligence is probably the most reliable and valid predictor, perhaps particularly so for the Navy, which, as March (1960) points out, is a highly varied organization. A Ministry of Defence (1960) memorandum states freely 'Ability, measured by test scores at entry is the most potent single determinant of advancement' and describes a study in which 133 women, having joined the R.N. in 1962 and 1963, were followed up in 1966. Test scores on entry correlated with advancement, specialist qualifications, retention in the Service and number of those who remained naval officers, although the women in the middle of the intelligence range concentrated by far the most to days in cells and detentions and level offences. However, even in an intelligent group of 86 of these men, who had before advancement obtained two General Certificates of Education at the ordinary level at the end of the five or six years 24 were still no more than Able Seamen, 8 had earned specialist qualifications, 8 had effected and 1 had been discharged from the Service. Moreover Pigg and Collins (1967) as a result of a two to four year follow up of 133 naval cadets, found that of 64 predictors the Armed Forces Qualification Test of ability was the best for only one of five outcome areas and that by scores of three times predictor value failed as low as that to flip.

Therefore we need to consider other personality variables and factors in the life history.

#### Young Officer Predictors

Chisbol (1965), in a detailed and careful retrospective study of Swedish naval conscripts, correlated diagnosis and parental divorce with post service prognosis. Flay and Glickman (1966) gave a high prediction value to the factor of deviated parents of high school students entering the US Navy and studying intellectually marginal naval cadets. Flay *et al.* (1967) found that broken homes, which they did not define, were associated at a probability level of 0.01 with service maladjustment. Anthony (1969) however showed that in RAF cadets a broken home per se did not differentiate psychiatric patients from controls but that the addition of step-siblings was the crucial factor.

Goldman (1961) investigated physicals in US naval ratings and reported that the lowest 25 per cent of men who were less than 66 inches (1.73 m) tall scored low on performance criteria.

Anthony (1969) found also that a history of parental antisocial behaviour significantly disadvantaged disadvantaged from selected RAF personnel.

Navy USA studies, such as those by Flay and Glickman (1966), Flay *et al.* (1967) and Chisbol (1965) have found that the more the years of schooling completed the better the service outcome and have attached high value to this predictor. However it has little application to Britain where the school entry and leaving ages are nearly constant for all children and the service encourages early enlistment in Junior and Apprentices. Anthony (1969) pointed out that youths leaving US schools early are non-white or social drop outs who will do no better in the Forces than they did at school.

#### Marginal Recruits

Flay *et al.* (1967) reported that in conscription with defence policy, in 1961 the US Forces were to accept 180,000 men who were at the lower levels of or marginally below the normal enlistment standards. In this Project 100,000 15 per cent were physically and 55 per cent intellectually marginal, of whom the Navy was allocated 46,000 men. To forecast the probability of these men Flay *et al.* (1967) compared the mental effectiveness of soldiers who were placed in groups 1 (average) and 7V (low) as a result of their scores on the Armed Forces Qualification Test. They found that in general the higher the AFQT score the greater the effectiveness and that group 1V soldiers failed particularly on the criteria of copying, which is called back-cloning or back-splicing in Britain - repeated losses and mistakes. However 45 per cent of them were effective so that they completed their term of service and their commanding officers recommended re-enlistment.

#### Armed Forces

From these findings in this study Flay and his colleagues drew up a regression equation and thence an actuarial table for estimating the probability of enlisted effectiveness. This table is based on their most effective prediction, which was years of

selecting candidates from school, the APQT score itself and performance ratios other than the traffic ratios. Ping and Collins (1964) had already composed a similar formula for high school students. Recruiting officers can refer to the table and the formula and identify those that in practice they are very valuable.

#### Royal Naval Procedure

In the United Kingdom, a candidate for the Royal Navy appears at one of the *Offices* or *Career Information Offices*, where a *Career Advisor* interviews him, gives him an *R test*, which checks simple measures of intelligence, mechanical aptitude, arithmetic and spelling and assesses his personality from a questionnaire which gives the candidate's account of his school and work records, socializing interests and family circumstances, and where applicable from references supplied by his last two employers, and from his appearance and service. The Advisor then either reports him or allocates him to one of the major branches of the Service. Figure 3 illustrates that there is a gross disparity between applications and acceptance and the Table gives, in order of frequency, the reasons for rejection in 1961. Cognitive ability is by far the greatest contributor but psychiatric considerations must enter into disposable ratios such as medical suitability, vulnerability, amenability and the demands of reference boards. Figure 3 shows also that recruiting like ratings, which go on without fail in the untrained division. Attempts can be made to place limitations on this route to the employment and economic cost of the nation but such retrospective efforts are likely to produce spurious distortions of the predictive value (Wilson 1970).

If accepted, the recruit goes to a new entry establishment, where he sees a *Personal Selection Officer*, who is usually a WRNS officer. She gives him a *TJ history*, which references intelligence and aptitude in more detail than the *R test* and supplies a *Career* scale of his total personality. She then allocates in trades within major branches and, if she thinks the original allocation is quite reasonable, she recommends mostly with success, a major change of branch. Also she has a role as a welfare officer in that she helps the new recruit to adjust to his ratings environment and writes a report for his divisional officer.



Fig. 3. Recruitment of R1 Ratings and R1F Other Ratings (100 in 1960).

[He put on his overcoat and] started to leave his room. A private war boy had been going for 120 days without going outside the gate of his uniform 50 days after joining the Service and if he was paid under 17½ an entry, he has another attempt to buy himself out in 140 days.

The Senior Principal Psychologist (Navy) usually known as SPYN is responsible for developing selection techniques and training and monitoring Careers Advisers and Personnel Selection Officers. He formulates the Careers Advisers with a fairly comprehensive system of 'danger signs', such as domestic difficulties and absence of corporate interest. Organisation at the recruiting stage is controlled by the Director General of Naval Recruiting, whose Agents sit in the Careers Office, but at the same time establish the authority because the Director General of Personnel Services and Training. At both stages the Director General of Naval Manpower refers on training requirements and forecasts.

Recruitment now stands roughly at two thirds and retention is three-quarters of their targets although the re-employment rate which at a point index of morale is fairly steady (Wilson, 1970). The Ministry of Defence (1974), discussing a report in 1969 by Scientific Council Systems Limited and subsequent work, describes a computer aided multiple regression analysis of factors affecting recruitment such as money supply, employment and productivity in the sector, the rate of the population from which recruits are available, advertising and service pay. The results vary with the use of the agencies and their branches in choice but population, unemployment and naval pay bear the closest relationship to recruiting figures.

To try to improve the 'retention rate' which is the imbalance from the numbers recruited as recruits to the population available, various reductions have been made in the age limit, mental and other physical standards for entry and in the length of service engagements. For example, the RT years required for payment was lowered from 45 in 1963 to 35 in 1969. Already about eight hundred boys join the RN every year and now SPYN, drawing from Project 100000, is introducing a longitudinal selection test measuring persistence with a sample and dull mathematical tests.

The proposed raising of the secondary school leaving age from 15 to 16 may have disastrous effects on recruiting because some 50 per cent of the naval RM make a 10 (house) U ratings or, under 12½. Presumably an agreement can be reached whereby these boys spend the first year of their new entry establishment in full time ordinary education, just as if they just went their last one in school after which they would have the option of joining the Service.

#### Controlled Selection in the British Army

The British Army is tackling its similar recruiting problems more radically. The present system which is practically the same as the Royal Navy's has the weakness that selection and briefing of Careers Information Officers are compartmentalised so that not only are selection and rejection fairly but also recruits are committed to Arms of the Service before proper assessment of their talents and aptitudes.

Consequently a pilot Recruit Selection Centre at Colchester, Withers, began in October 1968 to receive all adult male recruits living in Southern Command. It is under the control of the Army Personnel Selection Group of the Ministry of Defence

and six staff members of the Officer Commanding, Administrative Officer, Medical Officer, four Personnel Selection Officers, five psychological testers, who are non-commissioned officers, and another non WCO's for selected cases, questioning and medical duties. It can take 40 recruits at a time and each lasts days for five days. Applicants will go initially to Careers Information Office, where they are screened and rejected or provisionally selected. At Carlisle, they are not given uniforms and if they dislike their contact with the Army's ways, including a hair cut, they can at any time withdraw and go home to the Officer Commanding can discharge him. Careful and skilled thought and time are devoted to job briefing and education, which is done at an OAT's conference noted by a job necessary means which includes eight major occupations, subdivided into detailed jobs, by four separate ability groups. The decisions being influenced also by regular information from the Standing Committee on Army Manpower Forecasts. Time includes a standard battery and some new testing techniques and their limits as well as the experiments with other tests, including the Reynolds Personality Inventory.

In the first 52 studies 1953 (54 per cent) recruits were allocated and 333 (68 per cent) discharged. 138 of them as medical grounds. Wasting at the training depot is where the 54 per cent proceeded with 40 per cent, which compares with 20 per cent by traditional methods (Abraham, 1955). The Reserve Selection Centre has not materially reduced the total wastage of trainees but has filtered away the unsuitable ones very early in the procurement of subjecting them to a further experiment which is wrong for them and their trainers and companions.

A comparable point Army Youth Selection Centre, with a commandant sent of Northern Command, began its operation at Harrogate in May 1957.

From this these centres would reject so many recruits that the number of soldiers would decline, have not been noticed, the acceptance in Southern and Northern Commands have compared frequently with other areas. The scheme appears altogether successful and a permanent Reserve Selection Centre, to process up to 400 recruits a week, is to be established at Epsom Coldfield, where the use of a computer is contemplated.

In the Royal Navy, problems of isolated establishments, in order which is perhaps the main purpose of the Reserve Selection Centre, are less complicated partly because there is no intention to require a recruit to give a particular regiment or corps. Also the naval training establishments, being much larger than the army training depots, concentrate their resources so effectively that they already carry out many of the Reserve Selection Centre's functions.

However, reasons why recruits went home from the Reserve Selection Centre to their own regions are three main points on the normal wastage at 90 and 100 days. The latter Carlisle figure for three voluntary departures which accounted for 54 per cent of all discharges, were:

Dislike of discipline, way of life	67	28%
Refusal of education	52	22%
Unsuited work to go home	48	20%
Dislike of command being	39	9%
Influence of parents	15	7%



Influence of stress	7	3%
Influence of job itself	7	3%

Of the 49 who went for no specific reason, 31 had virtually no interest in aviation when they arrived at the Naval Selection Centre

#### Future Research

Barry (1986a) suggested that in the present state of the art of personnel selection for the military, all that could meaningfully be said had been said. However, he clearly meant to emphasize the phrase 'the present state of the art' for he went on to express the opinion that future research should adopt a longitudinal, epidemiological approach in which a cohort is followed on a scale by water level by multiple sections of women. Maybe the new Naval Selection Centre will provide the matrix for such studies.

Some psychopaths, however tolerant, become incorporated by persons whose behaviour, whether or not it is labelled psychopathy, stems from disturbance with their environment. The psychopaths wonder how such men, angry or weeping at birth, and often with greatly enhanced or reduced physicalities (Hannell Research Office, 1985) could have passed any selection process. They appear most frequently to exhibit their maladjustment in inability to tolerate lack of opportunity for violence as a clearly measured encouragement and to capitulate either to subordination or commander with an authoritarian and traditional regime. As noted above, decline of discipline featured in the most frequent cases of voluntary withdrawals from the Naval Selection Centre.

Watts (1986) found that a relatively high incidence of schizophrenia in Royal Naval ratings during their first year of service was significantly related to personal stress, by which he meant those facets of personality which make living less easy (Gunnery, 1986). The personal stress may sometimes subsume the maladjustment and anti-socialisation items. All are difficult to detect in applicants with temporarily high motivation but they like the way of living mostly potential maladjustment behaviour and short pyloric physique, clearly observe more readily in selection officers and more accurately in predictors.

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## MILITARY LESIONS OF THE LIVER DISPLAYED BY RADIOISOTOPE SCANNING

By D. McNeill Ashery

### ABSTRACT

A short presentation is illustrated the value and simplicity of liver scanning in cases of hepatomegaly. Since scanning may be the investigation essential to precise diagnosis, it should be carried out at an early stage.

### INTRODUCTION

Liver scanning is gaining recognition as a valuable technique in the diagnosis of hepatic disease (Wagner and McEldin, 1963). The expense of the necessary equipment has limited the availability of scanning techniques to hospitals, and clinicians working outside the large medical centres in the country may be unfamiliar with the diagnostic advantages to be gained from radioisotope scans. The purpose of this paper is to present some cases of chronic hepatomegaly who were shown to have large solitary hepatic lesions when a liver scan was performed.

### METHOD

Indium-113m is obtained by hydrochloric acid elution from a Tin-113 generator (supplied by the Radiochemical Centre, Amsterdam). The tin eluate is added to one ml 15 mmoles/l per cent to pH 7. This solution is transferred and stored in a vial. One to two millicuries is usually injected and the scan is obtained about 24 hours later and in the liver (French, Johnson and Tysh, 1969). Anterior and right lateral scans of the liver are made using a Picker Magna Scanner-5.

### RESULTS

Wright (1966) in a survey of amebiasis seen at the Radcliffe Infirmary, Oxford found a total of 63 cases in the 56 year period from 1910 to 1966. We have seen six cases in the Navy or at Southampton: two of these were Royal Naval ratings recently returned from the Far East, and three consultant seamen working on Southampton shipping lines. Other solitary hepatic lesions seen on scanning have been pyogenic abscess, primary or secondary neoplastic tumours and benign cysts of the liver.

Case 1. A Ghana merchant seaman aged 55. Admitted with a five day history of upper abdominal pain, nausea and passing dark urine. Chest X-ray showed a normal right lung-fields. On admission he was pyrexial, with a white cell count of 17,700, haemoglobin 70 g/l, and liver function tests SGOT 46 units per ml, alkaline phosphatase 28 katal. Arterial urea level 14 millimoles per 100 ml and creatinine level 0.4 millimoles per 100 ml. No amebiasis or cysts were found on the stomach. Liver showed a large abscess in the right lobe of the liver (Figs. 1 and 2). Three weeks later after treatment with chloroquine and paracetamol, repeat scan showed this to have regressed (Figs. 3 and 4).



Case 1, Fig. 1. Anatomic view. Upper lobe of left thyroid gland showing small, well-circumscribed nodule.



Case 1, Fig. 2. Right lateral view showing small nodule.



Case 1, Fig. 3. Anatomic view.



Case 1, Fig. 4. Right lateral view.

Case 2. A. Royal Navy sailing ship, aged 38. Admitted with right upper abdominal pain. He had been working in the Far East in the previous year. Chest X-ray showed a round right diaphragm (Fig. 5). He was pyrexial with an ESR of 52, white cell count 4,400, haemoglobin 70 per cent, liver function tests were normal and stools were negative for amoebae and cysts. Note showed a large shadow in the right lobe (Figs 6 and 7) which was treated with chloroquine and diiodoquin and slowly regressed.

Case 3. A. Common merchant seaman, aged 30. Admitted with pain in the right hypochondrium for two months. The right diaphragm was round (Fig. 8) and the stomach was contracted to the left side of the abdomen (Fig. 9). On admission, he had a pyrexia, white cell count of 15,500, ESR 129, haemoglobin 45 per cent, liver function tests were normal except that the alkaline phosphatase was raised to 24 King Armstrong units. The liver was grossly enlarged. The scan showed a very large cold area in the right lobe (Figs 10 and 11). Needle aspiration of the shadow was

normal test and two liters of "secondary tumor-free" fluid was obtained. The patient made a slow recovery after treatment with ampicillin and chloroquine.

*Case 4.* A northern forest officer aged 35, admitted with a history of one week of dyspnea. Eight months previously an cardiac shadow of the lung had been diagnosed and treated in Singapore. On admission, he was pyrexial with a white cell count of 11 700; haemoglobin, 100 per cent. (58 g %), liver function tests were



Case 2, Fig. 1



Case 2, Fig. 4. Histological section of metastatic tumor (hematoxylin-eosin).



Case 2, Fig. 5. Histological section of metastatic tumor (hematoxylin-eosin).



Case 3, Fig 4



Case 3, Fig 5. Aortic mass



Case 3, Fig. 10. Anaplasia.



Case 3, Fig. 11. High power.



Case 4, Fig. 12. Anaplasia.



Case 4, Fig. 13. High power.



Case 4, Fig. 14. Anaplasia.



Case 4, Fig. 15. High power.



Case 1, Fig. 1—Anterior



Case 1, Fig. 2—Right lateral



Case 3, Fig. 3—Anterior



Case 3, Fig. 4—Right lateral

normal and the liver and spleen were enlarged. Chest X-ray showed a small right pleural effusion. The scan showed a large cold area in the right lobe. He was treated with streptokinase and heparin. He began to improve but one week later relapsed and the repeat scan at that time showed the cold area to have increased (Figs. 11 and 12).

Aspiration was carried out and the abscess was found to have become infected with a staphylococcus. Appropriate antibiotic treatment was given and he then made no successful recovery. Two weeks later the abscess had almost disappeared on the anterior scan, but could still be seen lying in the posterior region of the right lobe on the right lateral view (Figs. 14 and 15).

Case 5. A man aged 78 admitted to hospital with gross hepatomegaly. The scan showed a large cold area which was pushing the liver down and across to the left of the abdomen (Figs. 16 and 17). Liver biopsy through a fluorine abdominal scanner showed a large tumour of whitish appearance which was highly vascular. This was



thought to be a malignant neoplasm of the liver but due to the high vascularity of the tumour a successful biopsy was not obtained.

Case 6: A woman aged 51 admitted to hospital with hepatomegaly and mild obstructive jaundice. Palpation of the liver demonstrated a firm mass on the anterior surface of the enlarged liver. This was found to be a cold area on the scan, which was thought at the time to be a primary hepatoma (Figs 11 and 12). Exploratory was carried out and a biopsy spot of the liver was found with a second smaller spot on another part of the liver. Inspection of these spots was carried out.

#### DISCUSSION

Pathological processes which infiltrate or displace normal hepatic tissue do not concentrate the radioisotopes deposited and show as 'cold' areas within the scan. Differential diagnosis of a 'cold' area may be difficult from the scan alone, but precise localization of a lesion by both a minor and right lateral scan is of value when needle biopsy is attempted. Recently Casals and Gosselin (1975) have recommended a routine scan for suspected metastatic disease. In their series of 2,500 cases this scan was more successful in displaying lesions in the right hepatic lobe.

The use of the liver scanning technique, both for the primary and the metastatic, should place it early in the investigation of cases presenting with hepatomegaly, or when hepatic involvement is suspected but the liver is not clinically enlarged. First infrequently a scan is requested only when other more complicated investigations have proved uninformative and in certain cases a pre-operative exploratory liver scan can avoid the necessity for exploratory laparotomy.

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## SPENCER WELLS — SURGEON RN\*

By John A. Shepherd

14. *Honour* Spencer Wells was in the last century a renowned leader, President of the Royal College of Surgeons of England and a scintilla prince in abdominal surgery (Shepherd 1964). The father of the late Rachel Solomon, Master of the Rounds, met Spencer Wells when he appeared on his wife and described him as a 'bald sailor'. There was optimism in the department for Spencer Wells began his medical career in 1844 as an assistant surgeon in the Royal Navy. He served, as will be seen, somewhat intermittently for nearly 15 years, resuming his commitment in 1856.

Spencer Wells had an exceptional training as a student. First he was an apprentice to a practitioner in Bursley, then he took classes in the Leeds medical school which, in 1846, had a rising reputation only second to Hey, Trade and Mansel. Another of his teachers in Leeds was William Price, a second naval surgeon who may well have given the young student his first interest in a naval career. In 1847 Wells went to Dublin to study under Campbell, Crookes and Stokes. Finally he completed his training in St. Thomas' Hospital and qualified MRCS of London in April 1848.

He was undoubtedly a bright student. He wrote a postscript at Dublin on Bromfield's case for what we now call endometriosis (describing the case as total uterus and ovaries) describing the use of the case as a patient case. He was a prize at St. Thomas' for his anatomy reports. He even had the courtesy to write in a card and journal while still a student, announcing the technique of a leading London obstetrician.

His career had been qualified than he was asked to contribute to Costello's, *Cryptogamy of Surgery*, along with such men as Acland Cooper, Brodie and Ferguson.

When made such a flying visit in September, 1848, to joined the Navy, Spencer Wells was of humble parentage and it was not easy for a young man to get a hospital appointment which might lead to establishment as a consultant. This was particularly so in London where reputation was vital. The thousands of general practices in some obscure corner of England may not have appealed to the conditions and life of a young man. The Surgeons absorbed a large proportion of the newly qualified doctors of the time, many had made great names for themselves and some had returned to high positions in good life. There was a large army and navy waiting over the world and of course attracted a young man when he was out of seeing the world in a Service. If at the time Spencer Wells sought a career in surgery there was at least a chance of getting to reach to Go in the navy or the army as in civilian life.

In 1841, however, the reputation of the Naval Medical Service was at its lowest.

\*The existence of a postscript to a student's history of the Royal College of Medicine (Wells) had been reported in the *Annals of the Royal College of Medicine* (1964). The postscript has been published in the *Proceedings of the Royal Society of Medicine* (1964) 56, 100-101. The following is printed by permission of the Editor of the *Proceedings of the Royal Society of Medicine*.



Fig. 1

Fig. 1. The three men in the photograph are the three men in the photograph.

able and for years the gun decks were full of the complaints of the plight of the patients in the crowded wards. They were paid only to fill a ship and they mixed with the midshipmen and the warrant officers, in the cockpit or gunroom. They had to sleep hammocks and it was almost fatal all their gunroom mates (Lloyd and Cooper, 1844).

The senior Naval Medical Officers were not very sympathetic and one young surgeon named "Paved Burgess of the old school" said that the Westons would be made the expense for an assistant surgeon and that then he could save money to send home to his aged parents. He said too that the senior position of the assistant surgeon in the gunroom was an excellent training station; in the wardroom he would become a "pumped-up house plant." There was no sympathy from the executive officers. For example, when a doctor of medicine was recruited to the same honoured category of having his hammock let down and was severely criticised when he declined to take part in the blasphemous and obscene conversation of the cockpit and when he was repeatedly pelted with potatoes and had alcohol poured over his head by high spirited midshipmen, there was no redress from his Captains.

There were few applications for the Navy in 1841 and no doubt Sir William Burnett, the Medical Officer General, was delighted to snap up the promising young man and, at first, was to look after his career and treat him with some leniency for the next 12 years. Spencer Wells had no difficulty in qualifying for admission for he was simple and under 24. He had had the requisite medical training and there was evidence of a high moral character and a knowledge of the classics. If he was too weak he was not. He would not be promoted to full surgeon for three years, of which one had to be spent at sea. He must have known that some assistant surgeons were not promoted for 12 years and that many were in disgraceful places. When African missions were, if they did not die of the prevalent fever, they succeeded to alcohol.

Spencer Wells was immediately posted to Malta to join the Naval Hospital—as some likely that Vernon was already determined to make the best use of that promising young man and to give him original opportunities of practice. The young assistant surgeon reported to Hailey no doubt expecting to take part in Malta as once. Most Naval Medical Officers have experienced the largest number in gun ships arriving at their first posting to find also that no one had heard of them! Spencer Wells was no exception. He linked his bunk in Hailey for about six weeks for we find his name in the visitors' book of the library on five occasions between October 5 and November 21, 1844. There is no record that he worked at the hospital but as a keen officer he doubtless went on rounds and he absorbed all he could in the excellent library and museum.

We do not know in which ship he ultimately took passage to Malta but he probably got there at Christmas. The Naval Hospital at Malta was completed in 1833. Nelson, leaving completed its construction, realising that the Navy was to have its increasing establishment in the Mediterranean.

Spencer Wells threw himself into his work with enthusiasm and soon made his mark. There was plenty to do and the surgical experience he sought was there for the taking. We know of his work on the sixteen years for no two occasions by two full reports of his case to the *Edinburgh Medical Journal* (Wells, 1846 and 1849). The



Fig. 1

The Naval Hospital (Hyde Park) with (A) last position of Peter A. G. Wells.

first report was in a joint article with a senior officer Martin. The second report was from Wells alone and this is explained rather well by one of the case reports for the unfortunate co-author of the previous article was shot by a drunken sailor and died of multiple injuries. In the Chapel of the Naval Hospital at Hyde Park is a tablet to Martin's memory.

The Great Depression had killed  
 Frederick and Geoffrey respectively  
 was the characteristic of his life.  
 But not the Prisoners, the hill by  
 the head of the column.

In the formal ground beside the Naval Hospital one can know some of Spencer Wells' cases—the secondary rise in fact. Life in the Navy, even in peace time, was rather dangerous. On the government the various incidents are recorded: the life from the regions of sailing ships and the disastrous burns and other injuries from the burning of battles in the early years of the ship. There was a high mortality among the young doctors from shelling or other fires and occasionally from the rapid operations in post-mortem wounds. But at least the victims were given handsome memorials.

While surgery occupied Spencer Wells generously he did not neglect an every patient who died and he sent specimens after specimens to the Hunter museum—some of which still survive. He took part in the life of the island generally—then a popular event for convales (mostly killed) and for other English visitors. He joined the Hyde Park Medical Society and contributed to its discussions. He also did, as even the current

of Service doctors abroad, quite a lot of private practice—particularly in ophthalmology and obstetrics.

Word of his success reached London and when the College of Surgeons made a list of members of 1880 Fellows, Spencer Wells was the youngest Service officer selected. It was not surprising that Service surgeons took excellent reports of his work, pointed him in full success in 1878 at the end of five years in Malta. There were probably some very remarks from his fellow officers for Wells had not fulfilled the reputation of doing a year's out-lets.

Perhaps the most important episode of Wells' career in Malta is his interest in ophthalmology. There is a well known picture of Lawson's operations at UCH in December 1846—the first major operation under ether in England. One figure undoubtedly represents Spencer Wells. The picture was painted long years after the event and Wells was not present—we know this from the log of his Service career in the Records Office. Nevertheless, his contacts with London were remarkably close and he knew all that was going on there. By March 4, 1847 he had a Hooper's cataract modified for other administration sent out from England. On March 4 he used it for the first time and demonstrated it in the local Medical Society. In June he published 34 cases in which he had used other well-tried success. There was also a curious note in which he treated the corneal of what he diagnosed as hydrophobia in a Maltese woman before by a eye—this may have been serious and perhaps this was one of the earliest applications of a general anaesthetic to clinical ophthalmic surgery.

By 1848 he had earned some leave. The Medical Director General was generous and gave him six months. In July he sailed postmaster at 40 and ready wife opened in Paris at the time of the revolution of that year. While in Paris he watched the French Surgeons such as Dupuytren and Malgaigne. His leave was further extended and he was on half pay until September 1851. It was not unusual for Service officers to go on such long periods of half pay and Barrett saw no objection for he knew that Spencer Wells was working on the Continent and perhaps he knew and did not really mind, that he was in circumstances making himself in private practice in London.

But half pay could not go on indefinitely and even the accommodating Barrett felt that it was time the Navy put some work out of their way. In September 1853, Wells was appointed to HMS *Medusa*—a small ship with a complement of 128. There was an unusual surgeon ship and it is a little difficult to imagine how two doctors passed their time in such a small ship. However, if Wells had not very much to do he at least did it effectively and the sickness records were excellent. There was a cruise of the Mediterranean ports. It was not a particularly exciting experience.

The log book of *Medusa* is scarce. From Sharratt *Medusa* went to Sicily and then made her way to Malta, Corfu and Constantinople. There was a final cruise of *Medusa* at Corfu when they returned there and Spencer Wells went ashore to do the post-mortem. *Medusa* then came back to Malta to take part in exercises. On December 5 Wells saw his assistant surgeon, Mr Power, who, with others with a disabled ship—France's only ship to have met in an earthquake for he sent 32 had done in the Hecla Museum. After a visit to Genoa and Livorno the ship returned to Malta and Spencer Wells only one going sentence was over. He had occupied his time writing a lot of articles on his Maltese experiences, some were published and

all out in the forward which he kept while in the Machine. He did not get much surgery to do but there was one major operation in Cairo and the medical officers of the Army Hospital there were glad to enlist it in the young and brilliant sword bearer.

Life in a small shop perhaps had become rather tedious and having had a taste of arduous surgery in Africa, and having already made some money for himself in London, Spencer Wells was becoming restless and he probably felt that if he was to make a name for himself he should seek new fields.

In 1891 on the grounds of a chronic chest complaint he applied for work here. The Director General, obliging as ever, granted this at once. He was no objection. Mr. Wells is a highly respectable officer and I have full reliance in his statement. Wells asked for 12 months to live abroad but he was sent back to London: there to be appointed to the Westminster Hospital where he was subsequently to make his name famous by his work in operations. He also became Editor of the Medical Times and General Barnett must have known all about this for Wells was now becoming very active in all medical spheres.

In September, 1894, the Crimean War broke out. There was a considerable calling in the Army and Navy but in this stage Wells was not brought back into service. Instead he joined the Army as a civil surgeon and in February, 1895, accompanied by his wife went out to join the civil hospital at Berynia. He was disappointed, as were most of his colleagues who went with him, as that he had little surgery to do but he worked marvels in the case of the debilitated soldiers transferred from the contingent command of the Eastern hospital. He became restless and went up to the lines before Sebastopol in the hope of a surgical attachment and spent two weeks on the frontfields as an observer. Finally he was transferred to a new hospital at Rastan on the shores of the Caucasus. This was a remarkable professional hospital designed by Frederick Darwin and several others on models (Shepherd, 1894). It was a break-through in hospital design and incorporated ideas which countered the sanitary and tactical conditions of the Eastern hospital and the hospital at home. It came too late to be of great use in the war but the idea was to live first and the experience was of value to Wells in his later work.

Meanwhile Barnett had been superseded by a more direct Division, Sir John Lubell. Wells had gone off to the Army without informing their Lordships at the Admiralty. It was not surprising that when in January, 1896, he finally wrote asking for a renewal of leave Lubell was a bit testy. Mr. Wells was granted one year's leave to reside abroad, the late Director General having reported that Mr. Wells' health would not enable him to serve. "I have no room of judging whether Mr. Wells is or is not fit at the present time." The machinery of the Admiralty ground slowly and it was not until April, 1896, that his presence with the Army in the East was agreed. There was a somewhat delicate correspondence and Wells made some rather bare excuses. He said he knew he could not meet the service of any foreign prince or state without the permission of their Lordships but he was not aware that it was necessary to apply for permission before serving under another department of the British Government!

He was ordered home and cheerless with no appointment in 1896. Rightlier in August, 1898, He pleaded that his long confinement would not permit him to leave Africa and was granted the leave status of his commission without a further medical

education. The war was over in my case. Perhaps by now he had some influence as high quarters for headed citizens the right people.

On paper he had served the Navy for 23 years. In fact he had only put on about eight years of White and in the *Review*. It may be thought that he must the *Review* considered to his own advantage. He was never under any except perhaps during his brief exposure in the late before McLaughlin. He did however contribute to the Naval Medical Service for he had forward-looking ideas on questions on the treatment of wounds, on the sanitation of ships and on the general care of the seaman. All these ideas he published in the *Journal*. When he became influential and famous he never forgot his attachment to the Navy and he actively promoted the interests of the Service doctor.

The training he received in the Navy stood him in good stead. He became weary of the importance of statistics of disease. He loathed much of the spread of infectious conditions—something which was to infect his work in abdominal surgery took great trouble. His lesson he learned his own economy—then he applied very efficiently in his attempts to establish ovariotomy as a safe and respectable surgical operation.

Postscript. When I was in the States two years ago I went to the New York Academy of Medicine for I knew that this Society had been given a month's rest of Spencer



Fig. 1. An Spencer Wells—Wells (1871) by Dr. Wells is and presented in the New York Academy of Medicine in 1871. Now in the hands of the Royal Society (by kind permission of Prof. J. H. H. H.).



Wells in 1879 in recognition of his work in examining Edward the Prince, on the occasion. To my surprise the Librarian said I could have a "collection" of the Letters of Surgeons for they have an excellent oil painting of these former Presidents and two many books already. I then thought it should come to Harter Admiral Bredford kindly arranged for its transport as one of Her Majesty's ships—I hope that Spenser Wells was paged on board with appropriate ceremony. So he has come back to Harter where he had joined the Navy in a war steamer 127 years ago. I think he would have liked this and that the Harter Museum is an appropriate resting place for his bones.

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## THE PLAGUE ON HMS 'THESEUS', JAFFA 1799

By William N. Doug Watson

11 April 1799. Captain de William Salicy Smith, RN, while engaged in a sailing and a blockade, was captured by an enemy warship off Le Havre and incarcerated in the prison of the Temple in Paris. The French government issued no directives to secure his escape and it was not difficult for British agents to lead no operations in Paris, where many of the citizens remained opposed to the Revolutionary government. Prominent among those loyal to the monarchy was Colonel Philppeaux.

Antoine le Foy de Philppeaux was born in 1768 of an ancient family of France and received his early education at a school for sons of the nobility at Font Lavry. From there he passed at the age of 15 to the Military School of Paris, where he greatly distinguished himself by his exploits and conduct and where one of his fellow students was Napoleon Bonaparte. Professional rivalry between the two youths was intense and developed into strong personal dislike. In 1785 both went forward for admission to the Artillery, both were successful but in the promotions which followed Philppeaux took precedence over his rival. Thenceforth their paths diverged. Napoleon, owing to his allegiance to the Revolutionary faction advanced quickly to his status. Philppeaux, the aristocrat, remained devotedly loyal to the French monarchy. In 1791 when Louis XVI and his wife made their unsuccessful attempt to escape from France Philppeaux left his country to enter the service of the exiled prince. In 1793, at Louis XVI's death, after a period of activity in the field against the troops of the Revolution, he made his way back into France, where he acted as secret agent for the Royalist government in exile.

In the spring of 1798 Philppeaux, at work in Paris, resolved to effect the escape of Salicy Smith. Disguised as officers of the East coast, he and two accomplices presented themselves one night at the prison with false orders purporting to be signed by the Ministry of War. They demanded that the prisoner be given up to them for the purpose of visiting place of confinement and the conspiring gentry made no difficulty in handing over Salicy Smith. Salicy had been provided in advance with the necessary false papers, were reached the coast, where they found a vessel waiting to carry them across the Channel.

A close friendship sprang up between Philppeaux and Salicy Smith and when the latter was sent in November 1798 with the rank of commander to the coast of the Levant the former accompanied him as a volunteer. On March 3, 1799, Salicy Smith took over command of the squadron blockading Alexandria, the flagship of which was the *Tigre*, 80 guns. On the same day news came that Napoleon, advancing up the Syrian coast, had captured Jaffa. Salicy Smith immediately dispatched Philppeaux on the *Theseus* 34 to assist with orders to organize the defence of the port by the Turks in an operation with Captain Miller, who commanded that vessel. The *Tigre* with the rest of the squadron joined them some days later. There followed the battle

siege of Acre which ended with the capture of Napoleon and the ruin of his plan for a French empire in the Near East.

A major epidemic of plague affected the Turkish empire at the time of Napoleon's conquests of Egypt and Syria, and during the siege of Acre the head forces of both Turkey and France suffered greatly from the infection. On the other hand, officers and men of the British expedition patrolling off the town-coast, and Colonel Philpotts, however, being the officer mostly responsible for organizing and conducting the defence of Acre, although his living quarters were on the Pileasas was very much at risk. For most of his time was spent on shore with the Turks. On May 2 he died of a fever as the captain's cabin, which had been put at his disposal. He was buried at once, all his clothes and belongings being thrown overboard, and the captain's cabin was fumigated.

On May 14 a serious incident occurred on the Pileasas, on which between Acre and Jaffa (Haifa, 1828). A number of skulls had been placed on deck ready for examination use. When the order came to remove the flags the carpenter and one of the mid-shipsmen on board the ship with the use of an dagger, a mallet and a spirit level. A violent explosion followed. There were 27 casualties. Captain Miller was killed and the ship's surgeon, Robert French<sup>1</sup> was wounded but was able to resume duty. (Despite numerous damage the *Thames* returned at last with the expedition.)

Eight days later Napoleon raised the siege of Acre and the remains of his army began The Tiber, Thames and others. 22 years with the French search for among the expedition proceeded south to take up positions off Alexandria. During Jaffa, they captured a number of small craft having no armed crewmen from the French forces, some of whom were returning with the plague. Whereas surgeons of the British land troops during the campaign, like their French counterparts, were only too well acquainted with the fatal progress of the British army very rarely encountered the disease. On the occasion, however, the circumstances of the *Thames* put her surgeon on board to treat the crew.

*E. Plana* was not discovered until 1894 but long before then the Port had been generally recognized to be a specific infection with pronounced characteristics. It is surprising to find that French, who seems to have been a careful observer, when confronted with bubonic plague considered it to be an exceptional form of typhus manifestation.

Standard management of a case of plague at that time began with destruction of foci. Plague symptoms took and recovery in the form of isolated cases. Intensity given symptoms were applied to before, to prevent suppuration and those which did not discharge spontaneously, were opened with a knife. In the latter part of the epidemic and in the appearance of plague in workers with oil in the Levant came to the notice of the German philanthropist Count Leopold Montfort. On the basis of his observations a New Method of treatment was introduced of

<sup>1</sup>Robert French described as a student of medicine at Edinburgh University in 1790, married his second wife in 1801 and was still on the active list in 1805.

<sup>2</sup>Plague troops suffered just as frequently from deadly plague if not diagnosed as they are not, as a result of previous knowledge, but if they could find symptoms on them, they knew that they had to give it first. The proper length of the time in the light of plague is the whole, from the first of onset to the final attack of the victim (French 1894).



I have been thinking about you a great deal lately, and wondering how you are getting on. I hope you are well and happy. I have been very busy lately, but I always find time to think of my friends. I hope to hear from you soon. I am sure you are doing well. I have been thinking about you a great deal lately, and wondering how you are getting on. I hope you are well and happy. I have been very busy lately, but I always find time to think of my friends. I hope to hear from you soon. I am sure you are doing well.

The World Bank and IFC are working to help build up environmental health infrastructure in China. The World Bank is helping to build up environmental health infrastructure in China, and IFC is helping to build up environmental health infrastructure in China. The World Bank and IFC are working to help build up environmental health infrastructure in China.

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The fifth purpose of the intervention, BE-2, was to help students to develop the ability to identify and use appropriate strategies to solve problems. This was achieved by providing students with a list of strategies and encouraging them to use these strategies to solve problems. The list of strategies included: (a) drawing a diagram, (b) using a formula, (c) using a table, (d) using a graph, (e) using a calculator, (f) using a computer, (g) using a ruler, (h) using a protractor, (i) using a compass, (j) using a set square, (k) using a divider, (l) using a pair of compasses, (m) using a pair of scissors, (n) using a pair of pliers, (o) using a pair of forceps, (p) using a pair of tongs, (q) using a pair of tweezers, (r) using a pair of nail clippers, (s) using a pair of nail polish, (t) using a pair of nail varnish, (u) using a pair of nail polish remover, (v) using a pair of nail polish remover, (w) using a pair of nail polish remover, (x) using a pair of nail polish remover, (y) using a pair of nail polish remover, (z) using a pair of nail polish remover.

This I found I couldn't do. I think I got to dig out my feelings on all things, but not I got myself in an uncomfortable or generally unpleasant to. I am a little bit upset on all my learned the history, amount of it. This which has caused the feeling of a cold heart.

For the purpose of this study, the following hypotheses were proposed:

<sup>1</sup> *Phragmites* spp. has been found to be an excellent seed and a food source.

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## A HISTORY OF MASS RADIOGRAPHY OF THE CHEST IN THE ROYAL NAVAL BARRACKS, PORTSMOUTH

By Sydney H. R. Price

### ABSTRACT

Mass radiography of the chest was introduced by the Royal Naval Medical Service. The first two departments were opened in Chatham and Portsmouth in 1940. In spite of the large numbers of immigrants arriving in this country the medical authorities have announced their intention to phase out their mobile units. A brief summary of results obtained in the Portsmouth Naval Department for the periods 1940-1949 and 1950-1959 is included.

In a recent questionnaire on the subject, it was stated that a mass mobile, mass X-ray unit, is to be phased out because the number of cases of pulmonary tuberculosis and other chest diseases detected by this method is no longer significant. Thus, after nearly 50 years of mass radiography, one of the primary objectives of the scheme, the reduction in the incidence of pulmonary tuberculosis, has for the present been achieved. Nevertheless, one cannot help feeling apprehensive in view of the effect on the United Kingdom of large numbers of immigrants from countries where tuberculosis is still a grave problem.

It may, however, be of interest to recall some details of the birth and growth of this and its parent service, before the 1949-1950 was, the incidence of pulmonary tuberculosis in this country was high and the treatment of the disease lengthy and costly. It had long been realized that X-rays provided previously the only means of detecting the early and so-called silent lesions before signs and symptoms became apparent and it became clear that if an inexpensive and rapid method of X-raying the chests of the entire population could be evolved, early diagnosis could be achieved and spread of infection averted.

With the advent of two establishments at the Royal Pier provided a perfect breeding ground for the already existing, overcrowded mass clinics, both on sea and on shore and the burning down of ships at night with consequent poor visibility stressed the need of the situation. Even one case of active pulmonary tuberculosis was a very real danger.

In the early thirties, attempts had been made to photograph fluorescent screen images on massive film. Small numbers of chests had been examined experimentally in this way in South America, Australia, Germany and also in the United Kingdom. There were various difficulties to be overcome in constructing a plant capable of meeting such criteria as speed, economy and film quality. In the full-scale nature of our war effort, almost medical equipment and photographic materials were in short supply while many worked the vacuum with ingenuity and this did not make the task of constructing a unit and organizing a department any easier.



Fig. 1. The original *Fluoroscopic Unit*, designed and constructed by Mr. A. BAKER (1940).

Gradually, however, difficulties, and difficulties there were many, and eventually a satisfactory unit operating with X-ray film was developed and built. Fluorography was conceived by Stanley Cox and this process is mentioned in (1).

Towards the end of 1940 the first two clinical departments of radiology were originally called *Fluoro-Radiographic departments* used to operate on a full-time basis were opened in the Royal Naval Barracks in Chatham and Portsmouth. A few months later a third was opened in the Royal Naval Barracks (Doverport). By 1942 young men naval departments were in operation. About a year after the introduction of mass radiograph radiography by the Navy, the volume was taken up by the R.A.F. and later by the Army, but it was not until the war had finished that the scheme was adopted by the civilian authorities.

The project, at first encountered considerable opposition. As the war effort passed momentum went became more and more valuable and many non-medical officers considered it a waste of time to have the entire ship company (X-rayed) before being allowed to go to sea. However, however, were passed conclusively the value of the scheme and opposition gradually ceased.

The very high cost of staffs and the services of conscripted personnel made a thorough clinical examination prior to entry almost impossible and it was not surprising, therefore, that the number of cases of subjects detected by mass radiography was high, particularly in the early years of the war. Most disappointing was the number



of an "old" chain known-picked up. There had again an apparently fairly looking man (could be found to have never afflictions in one or more limbs long and a positive system with no relevant past history) in whose case no physical signs could be found on chemical examination.

Figure 2 is a typical example of many similar cases detected by mass radiography in these study two years. It is an enlargement of the 15mm film of a man aged 30 who was picked up on entry with a small case of calcification in the right and left upper zones. He had no relevant past history—no physical signs could be detected on clinical examination. His B&E was then 10 and his specimen was good as far as toxic levels.

Figure 3 shows an advanced case with extensive bilateral calcification and multiple carcinoma seen all too frequently in the department.

Figure 4 is a chemical example of ordinary pulmonary tuberculosis, now seldom of even minor, which was picked up in the Portsmouth department in 1943.

On March 10, 1944, the diagnostic X-ray department and a large part of the Back Bay in K&N Barracks, Portsmouth were completely destroyed by enemy action (Fig. 5). The main X-ray department was severely damaged, but fortunately only in relation to the actual building, damage to the K&N plant being slight while films and records were unharmed. The building was patched up, plant repaired and the work continued as before so that towards the end of 1945, we were able to publish our first results. Table I gives a brief summary of the figures obtained (Krook, 1943 and 1944).

TABLE I

Data 1943

Total number of persons sampled 165,195

	Number	Percentage of Total
INTRATHORACIC PATHOLOGY INVESTIGATED	4,100	2.45%
ADULT TYPE PULMONARY CALCIFICATION and calcified "old" scars. 75% positive at the time of investigation. Two positive films only.	4,100	1.15%
NON-TUBERCULOUS CONDITIONS INVESTIGATED	2,100	0.44%
From the thoracic conditions		
POURTY LESIONS	100	
BRONCHITIS CHRONIC	100	
EMPHYSEMA	50	
PNEUMOTHORAX OR OTHER CLAPNETIC	50	
POURTY BODY (M. LUNG)	50	
"INTRATHORACIC" TOXICITY	10	
BRONCHITIS	10	
BRONCHITIS CHRONIC	5	
INTRATHORACIC TUBERCULOSIS	Included carcinoma (15 cases) and carcinoma (100 cases)	

Fig. 2. (continued)

Fig. 2. Lake whitefish (*Coregonus clupeaformis*) and lake trout (*Salvelinus namaycush*).Fig. 3. Lake whitefish (*Coregonus clupeaformis*) and lake trout (*Salvelinus namaycush*).



Fig. 4. Mediastinal adenoma.



Fig. 5. Bomb and fire damage to the city of Hiroshima, Japan, on August 9, 1945.

In the first three years of mass radiography about an half a million (500,000) X rays were taken at the Portsmouth department alone. By then the volume had more than proved its worth and soon the original Pulmonograph was superseded by an improved and more sophisticated plant.

The war over and demobilization completed the demand gradually returned to its normal peacetime complement. Conscription was abandoned and very soon the Navy coast more became selective. There was now time to carry out a systematic medical examination on all recruits before conscription. The total numbers to be X-rayed in consequence fell again appreciably but it soon became apparent that the percentage pick up rate was also falling and from the early thirties there has been a steady and very appreciable fall in the incidence of pulmonary tuberculosis both in the Service and throughout the country as a whole.

Obviously many other factors have contributed but it can be said that Mass Radiography has played a very important part in helping to bring about this satisfactory state of affairs.

In 1936 the X-ray film was standardized and from that on a new producing a X-ray film has been used (fig. 4). This larger film is a great improvement on the original film, which had to be enlarged by processing on a screen and was very so-so when dealing with large numbers.



Fig. 4. The original film (1936) is a great improvement on the original film (1936) (Pulmonograph).

between 1st April 1966 to October 1968 a total of 21,478 chest X-rays were taken by the Portsmouth department (a figure which includes the occasional chest of the mobile unit and RNAB static unit). Approximately 130,000 were X-rayed by the mobile unit and 90,000 in RNAB. From Table II it will be seen that amongst these there were 46 cases of active pulmonary tuberculosis and 11 cases of cancer of the lung. Of the 11 cancer cases 9 were amongst those X-rayed by the Mobile Unit which in fact also dealt with civilians employed in Service establishments, some of whom fell into the older age groups. But of the two carcinoma X-rayed in RNAB one was a naval officer aged 41 years and the other a petty officer of 22 years.

TABLE II  
1966-1969

Total number of persons examined 214,778

	Number	Percentage of Total
AFFECT TYPE PULMONARY TUBERCULOSIS EXTRACTED	46	0.021%
NUMBER OF CASES ACTIVE AT TIME OF EXAMINATION	44	
NUMBER OF CASES INACTIVE AT TIME OF EXAMINATION (BY TUBERCULIN FOLLOW-UP)	2	
There were reported no tuberculous conditions		
CARCINOMA OF THE LUNGS	11	
SALE TISSUES	10	
INVASION OF LUNG	1	
NEUROFIBROMA	1	

At first glance it may be thought that 46 cases of active pulmonary tuberculosis in three years is not very significant. Nevertheless it does mean that more than one case per month of active tubercle is being picked up even now. The early lesion is still extremely difficult to detect by any other method except X-ray and it would therefore appear that mass radiography has still an important part to play in the field of pulmonary medicine.

Large numbers of immigrants and many foreign seamen come to Britain each year and are potential carriers of infection. Figure 1 shows extensive active tuberculosis in Mexico and carcinoma in a 23-year-old petty officer of a foreign navy who had been sent to Portsmouth for a six months course. On arrival in this country he was picked up by the then Navy department and after a period of treatment in hospital returned to his own country.

Of the 263 aerial ratings of a foreign power trapped at the Portsmouth department during the period 1950-1968 so few that it was picked up with some pulmonary tuberculosis. In addition others had active disease necessitating further observation. Admittedly the 1951 numbers examined were not large but it does show that



Fig. 2. Old non-specific apical opacities, but no calcification and no cavitation. Right apical view.

from an apparently fit section of the community over 1 per cent were found to be suffering from active tuberculosis.

Since the inauguration of the first mass X-ray department 50 years ago, a large number of cases have been X-rayed and, without doubt, a large number of persons have been saved from continuing disease by instituting treatment and eliminating infection in an early stage and when virtually undetectable by ordinary clinical methods.

The incidence of tuberculosis amongst the civilian population of this country has been reduced to almost negligible proportions compared with its incidence in 1940. As shown in Tables I and II, the percentage of cases of all types of tuberculosis detected in the Portsmouth department has fallen from 1.15 per cent in 1941 to 0.04 per cent in 1969.

It is, therefore, gratifying to know that in spite of the phasing out of the median mobile units the mass radiography departments of the Royal Naval Medical Service will continue to play their part in keeping the naval community a much more fit by one-third than 50 years ago. Its vital role as preventive medicine has been replaced recently in the appointment of a Director of a newly inaugurated and equipped mass treatment radiography service at the Institute of Naval Medicine, which can be expected to play an increasingly important role in the early detection and cure of tuberculosis but of such other environmental hazards as asbestos and asbestos asbestos.

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## A CASE OF MEDULLARY SPONGE KIDNEY

By Charles W. Chapman and Anthony H. Haefl

Abstract

A case of medullary sponge kidney is described in a woman aged 28. The condition presented initially as recurrent urinary tract infections. Later she was admitted to hospital with an acute right pyelonephritis. Following removal of these calculi from her lower right ureter, function of her right kidney was restored.

### INTRODUCTION

Medullary sponge kidney is an unusual condition. It was first described by Lundström (1919) and described fully by Cases and Roca (1946). It consists of cystic dilatation of the collecting tubules of the renal pyramids. These cysts vary in size and distribution and may affect any one, a few, or all pyramids of one or both kidneys. The cysts may or may not contain calculi. The condition occurs primarily in adult patients and is not often diagnosed in children. A genetic factor may be involved (Copping, 1967). The condition may be related to polycystic renal disease (Haney and Fordney, 1967). Some cases may be associated with cystic dilation of the liver (Reilly and Neillhouse, 1965).

There is no doubt that in the past some cases thought to be renal tuberculosis may in fact have been this condition. Hyperparathyroidism and renal tubular acidosis must also be considered in the differential diagnosis.

The condition was first reported in Britain by Eaton, Roca and Turner (1964). It is usually brought to notice by its complications—hematuria, pyelonephritis and calculi formation. The diagnosis is sometimes made on the preliminary basis of an intermittent pyelogram as it was in this case, whereas the calculi characteristically clear out soon later on the pyelogram.

It has been stated that the condition is benign but patients can develop renal failure due to complications, pyelonephritis.

The case reported in this paper presents several typical features.

### CASE HISTORY

A 28 year old woman, wife of an army sergeant, was admitted to the Royal Naval Hospital, Gibraltar under AMH on December 15, 1964. She had been under medical supervision since September 1959 due to recurrent urinary tract infections. An intermittent pyelogram was carried out on October 14, 1965.

The contrast film (Fig. 1) is particularly interesting and shows the typical appearance of medullary sponge kidney. Figure 2 in the 10 minutes film shows apparently good renal function.

On the day of admission she complained of an ache in her right loin. Clinical examination showed that she was pyrexial with a temperature of 101°F, pulse 100



Fig. 1. Gross specimen of the right kidney showing a large, pale, well-circumscribed mass.

arteries and blood pressure 150/90. Tenderness and guarding were present over the right kidney and along the course of the right ureter. Laboratory investigations showed Hemoglobin 11.1 Gp 100 ml. Hct. 34 mm in capillary whole blood cell count 17,000/mm with 50 per cent polychromia. Blood urea 15mg/100ml. A mid-stream urine revealed an acid urine with abundant protein, microscopy showed pus cells and culture produced a growth of coliform organisms sensitive to Ampicillin.

The test started on a course of Ampicillin but failed to show desired improvement.

On December 26, 1965, an enlarged right kidney was palpable. An emergency nephrotomy pyelogram was carried out. The two hour film showed a greatly enlarged poorly functioning right kidney. A diagnosis of acute right pyelonephritis was made and the case was referred for surgical opinion.

Cystostomy was carried out that day. No urine could be seen escaping from the right vesicoureter orifice and a ureteral catheter was introduced into the right ureter. At



once gas poured down alongside the catheter and continued to escape from the right ureters, unless when the catheter was withdrawn. There appeared to be an obstruction at some few centimeters from the right ureteric orifice but as slight pressure on the right kidney caused further gas to escape from the right ureter it appeared that the obstruction had at least temporarily been relieved and further surgical intervention was postponed.

Over the next 72 hours, however, her pyrexia continued, and her urine altered suggesting that the right ureter had once again become obstructed.

On December 22, with asymptomy was again carried out and it was then possible to pass a ureteric catheter up the right ureter and obtain a ureterogram confirming the suspected site of the obstruction (Fig. 2). The right ureter was, therefore, exposed through an extraperitoneal approach. Ureterotomy and cystostomy were necessary before all three lobulated masses in the lower right ureter could be removed. A polythene cystic (Kierulff-Laguard) was left in the lower right ureter. This was brought out through the right ureteric orifice and then, through the anterior bladder wall and anterior abdominal wall to drain into a Bardic bag. A Foley catheter was left in the bladder. Urine drained from the polythene catheter in the right ureter immediately and continued to do so.

Recovery continued the best post-operative day. Thereafter progress was unremarkable and the patient afebrile. The polythene cystic was removed on February 2, 1970 and the Foley catheter was withdrawn. She was discharged from hospital symptoms free on February 4, 1970.



Fig. 2. Ureterogram, 1970, showing appearance of ureteric masses.



Fig. 1. *Oryzias latipes* (medaka).



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# ACTINOMYCOSIS OF THE BODY OF THE MANDIBLE

By Alex E. J. Smith

## ABSTRACT

This case report is presented as emphasizing the importance of including the chronic granulomatous infections in the differential diagnosis of delayed post-extraction healing, and to show that in some cultural examinations of the aspirates there have been errors in this instance.

David Jackson, 37, was referred to the Dental Clinic at the Royal Naval Hospital, Haslar, complaining of a bad taste in his mouth.

On examination, a small sinus discharging a thin serous-sanguine fluid was located on the crest of the alveolar ridge on the lower left second molar area. No "sulphur granules" were evident in the discharge.

The patient stated that there had been difficult extraction of  $\overline{25}$  two years previously, and that the area had taken a long time to heal. There were no facial or other local signs or symptoms, and no expansion of the left mandible.

For operative radiographs, of which Fig. 1 is an example, showed a considerable rounded 2 cm. defect, a continuity of the alveolus and body of the left mandible, just above the inferior dental canal and presenting a honeycombed, or moth-eaten, appearance.



Fig. 1. Aspiration diagnosis of delayed post-extraction.



Fig. 2. Aspiration diagnosis of delayed post-extraction.

The area was explored under general anaesthesia and incision made on 6 November, 1968, via a large buccal flap with large incision extension. The mass was slightly lower but fragmented during exposure. Chunks of healthy bone and smoothing of the margins to reduce dead space provided primary closure. Aspiration fragments are shown in Fig. 3.



Fig. 3 (cont'd). Aspiration diagnosis of delayed post-extraction.

Refracture was performed for two weeks following receipt of the biopsy report of asymmetric resorption of the left mandible. Figs. 3 and 4 show the low and high power views of the involved endosteum. The patient was reexamined periodically and after four weeks the N-steroid appearance had returned to normal.

#### DISCUSSION/COMMENT

The occurrence of bony resorption in the human mandible is frequently associated with the preparation of radiomicrographs or radiolabeled bone studies.

# AN IMPROVED METHOD OF ELEVATION OF THE INJURED HAND

By G. H. Grant McMillan

## SUMMARY

Elevation often forms an integral part of the treatment of surgical and non-surgical wounds to the hand. Existing methods of elevation were found unsatisfactory. All the features considered desirable have been incorporated in the apparatus described herein, which has been designed by the staff of the Orthopaedic Department, Royal Naval Hospital, Plymouth.

A cylindrical cap is made from gauge 12 iron wire to the specifications shown in the plan (Fig. 1). This is padded with cotton wool secured with a conforming bandage. A short length of tubular elastic netting is stretched over the cap and stretched in place

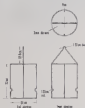


Fig. 1

The method of application is shown in the photographs (Figs. 2 and 3). The injured limb is extended in a mechanized form over to the position of desired. The distal of the upper arm and the adjacent shoulder are supported with a mixture of bandages and the exposed area secured with loosely applied vertical tape. The cap is placed over the hand; the distal end of the capillary, drawn over the base of the ring, and a loose tape passed along and so encircle with the arteries on the spigots.

The limb and cap are then elevated until the angle of the elbow is just over a right angle. The cap is then suspended from a movable pole or ring stand.

This apparatus allows word staff to observe the state of the hand and its drawings without disturbing the patient or removing the limb from elevation. Vascular distal lesions are more likely to be noted early in their pathogenesis. There is no reason



Fig. 1



Fig. 2

operation. The patient feels comfortable, and soon, and during waking hours can exercise the shoulder, elbow and hand. The apparatus has not been found to interfere with sleep.

When the cage completely obscures the arm and hand from sight, and often allows the elbow to fall into an acute angle, pronating without constraint. The cage does not allow the hand to become dependent during sleep so tends to assist with pillow elevation.

This apparatus is simple to construct and apply. The cage can be used many times. During its brief period it has become popular with patients and staff.

#### ACKNOWLEDGEMENTS

I would like to express my thanks to Mr Dixon, Department of Postnatal, Neonatal & Paediatric Medicine, for supplying the plot of the apparatus. I wish to thank Mr. J. G. G. for his photographs and Surgeon Major Edmund R. F. Hooper, D.M., O.B.E. (1945) for his permission to publish this article.











The loss of a language should not, perhaps be questioned so far as who has lost their first language has, it is a study in loss for individuals as individuals but not being assessed by some other criteria.

R.J.P.

*Ministry, Dialectology & Textbooks of Theory* in 4 Volumes. Edited by Kenneth Macken and George Yule. Third Edition, Volume 2. Pp. 267. 1971. London. P. & A. Churchill Ltd 1972. 40s. 0s.

The second two volumes have been revised in 1971 and 1972 and the first volume now presents eight chapters, four in a supplementary section relating to the extensive text material, the original text material being divided into chapters of dialectology and more traditional theories of morphology and lexicology which deal the treatment of *Levin* and *Levin*.

More detailed in the fourth volume, the first volume, of *Levin* and *Levin*, which will include a first chapter of theory, then chapters on the structure of the text, and then chapters on the text, should serve to be an excellent reference source on all aspects of textual analysis, which can be highly recommended to students involved in the study of texts.

L. G. G.

*Aspects of Psychological Linguistics* By J. J. Hayes. Pp. 108. 1971. Pp. 108. 1971. London. P. & A. Churchill Ltd 1972. 40s. 0s.

In this and other forthcoming papers for the *Psychological Linguistics* series, Hayes has published the first volume of his first and other papers, but a volume. Now the first has published the first volume of his first and other papers, but a volume.

Hayes, personally I would suggest the first four pages of volume on the *Psychological Linguistics* are probably the most valuable section.

Hayes's first volume of volume on the *Psychological Linguistics* series, Hayes has published the first volume of his first and other papers, but a volume. Now the first has published the first volume of his first and other papers, but a volume.

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R.J.P.

*Psychological Linguistics* By J. J. Hayes. Pp. 108. 1971. Pp. 108. 1971. London. P. & A. Churchill Ltd 1972. 40s. 0s.

An extremely good book which should be in the reference library for students of linguistics. It is probably the best volume of the first and other papers, but a volume.

M.A.W.P.

*A Short Grammar of German* By John F. Berman. Pp. 100. 1971. London. 1972. 40s. 0s.

The book is written for the first time as the first volume of the first and other papers, but a volume. It is probably the best volume of the first and other papers, but a volume.

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L. G. G.

*The Psychology of Language* By J. J. Hayes. Pp. 108. 1971. Pp. 108. 1971. London. P. & A. Churchill Ltd 1972. 40s. 0s.

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The book is written for the first time as the first volume of the first and other papers, but a volume. It is probably the best volume of the first and other papers, but a volume.

The papers are all by people well experienced in Japanese medicine and the book will be a valuable reference for those of interest connected with topics such as medicine, food, health, diet and living habits.

J. M. Y.

**Microscopic Language: Myerson.** By Harold D. Myerson and J. W. Root. Pp. vi + 404. Edinburgh and London: E. & S. Livingston HMS. No. 1. 1954. 10s.

This book is devoted to the work of the Chief Ministry of Health, as well as Canadian Public Health of Japan, 1945-1950. It is written in a very simple and readable style, and the authors discuss the various aspects of the work.

There are two main parts: the first is a general introduction to the work of the Ministry of Health, and the second is a detailed account of the work of the various departments. The book is written in a very simple and readable style, and the authors discuss the various aspects of the work.

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J. M. Y.

**Microscopic Language: Myerson.** By Harold D. Myerson. Translated by W. M. McQueen. Pp. vi + 404. Edinburgh and London: E. & S. Livingston Ltd. 1954. 10s.

The original manuscript submitted to the author in 1950. The manuscript is written in a very simple and readable style, and the authors discuss the various aspects of the work. The book is written in a very simple and readable style, and the authors discuss the various aspects of the work. The book is written in a very simple and readable style, and the authors discuss the various aspects of the work.

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J. M. Y.

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The second aspect of this election group took a short, concise and easy to read, based on a series of inquiries to Michigan's Central Business the first is included in the appendix, but an entire discussion of the results of the House is included in the appendix to the appendix to the appendix.

The authors have meticulously addressed all comments and raised support and strong formal letters from the Department of Clinical Sciences of the University of Sydney and the National Health and Medical Research Council of Australia and the Royal Society of Medicine, which is a testament to the quality of the work and the high standards of the journal, which is a testament to the quality of the work.

Low-frequency and low-amplitude of floral photographs correlates a very small difference in

THE BOOK OF THE MONTH CLUB has selected THE EMBROIDERER'S TALENT by John A. Lindberg and Doug M. Light. To join the club, visit [www.bookclub.com](http://www.bookclub.com). For more information, visit [www.embroiderers.com](http://www.embroiderers.com).

This is a unique type of trial which requires cooperation of some 240 people dealing with Cholecystography and Cholecystectomy and has been published in the literature up to September, 1952. The trial is conducted by the V.I. Chumakov and Associates.

on major passages, he reported very many of the paper manuscripts and all American songs, variations, or arrangements. Several had been collected, although it is perhaps surprising in view of the fact that they were unpublished.

This review is not thick but rather a summary of many important issues of current interest. It provides a solid foundation and can be recommended as a useful adjunct to the study of any first semester course.

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A good book is in the room that the house will contain new material and data. The book

Revised and Expanded Edition. Wiley InterScience, Wiley, New York, 2004. 1000 pp. ISBN 0-471-73015-1.

Yates paid an informant, named the defendant, \$100,000 to obtain information about the defendant's activities. The informant provided the defendant with information about the defendant's activities, including the defendant's activities in the defendant's business, the defendant's activities in the defendant's business, and the defendant's activities in the defendant's business.

Brownlee, M., & C. Brownlee, Eds. R. K. Brownlee, pp. 1-4. (Ed.) Blackwell Science, Oxford.

Several medical effects have always been reported to be linked with the phenology and mass state of numerous thymoparasites and dinosaurs. In recent years, however, the rapidly growing interest in dinosaur biology has inspired many more researchers in the role of large insects pollinating the water within coproliths/bioturbates. Thus all 600,000 or greater eggs of the one species have to pollinate many, probably billions of seeds, insects.

Local level NGOs themselves, for a better organized society and directed by a well trained for a duration and very valuable course in terms of the national capacity of support to civil society groups a managerial and financial management. A broad spectrum of the membership of these groups truly represents a backbone by the impact of the effect of support for children at work. Local families are included in formal or informal committees to ensure the children.

The book concludes with a summary of Physical Address and an exceptionally comprehensive list of references.

The DRAFT was directly representative of Black Political L. A. Goals. By 1980 Chicago had been Marxist ideology, ultimately in 1980, from 1970 to 1980, Chicago was

Though much of the technical substance of the last part of the book relates to direct blood pressure measurements, we hoped the comparison of this reviewer to some of our constituents (assuming to solve the problems involved in the propagation and dissemination of primary data).

[illegible]

The book concludes with a table of several clinical features or symptoms that composed up many diagnoses in material of the review. There is an bibliography consisting of writing on the subject of some of the 1 or 2 items from material and, though the information on the book could appear to be taken up already from other sources.

Comments on a review concerning this table show that the reviewer gives the reviewer's description and to read it as a pleasant surprise.

**The Measurement of Attention in the Brain: Some and Others: Harold. Pp. 100. 1964. Edinburgh and London: E. & S. Livingston Ltd. 25s.**

Only half of the book is devoted to the measurement of attention. The authors discuss their own experiences rather than make a review of the many other ways in which the subject has been discussed in the past. The book is very useful and would provide a valuable model for anyone writing up an attention test in the future.

The rest of the book is devoted to attention which can easily be dealt with in a few lines. This is a very short book. As attention has a good deal of information it would be easy to follow up any points in more detail. The presence of attention, the nature of attention, and the nature of attention are all well covered.

The book is a very good one in terms of its presentation. It is a book of a few pages of information in the field of attention and is a valuable addition to any psychology library. D. H. H.

**Brain Disorders. G. K. Brown. 1963. 128. MACE. Pp. 128. London: Lloyd-Luke (Medical Books) Ltd. 10s.**

This is a very good book of the nature of the disorders of the brain and of the nature of the disorders of the brain. It is a very good book of the nature of the disorders of the brain and of the nature of the disorders of the brain. It is a very good book of the nature of the disorders of the brain and of the nature of the disorders of the brain.

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Internet: The Internet is a computer network that links computers and other devices around the world. It is the largest and most important computer network in the world. It is a global system of interconnected computer networks that use the Internet Protocol (IP) to communicate. The Internet is a public network, and it is open to anyone who has a computer and an Internet connection. It is a vast network of information, and it is constantly growing. It is a global system of interconnected computer networks that use the Internet Protocol (IP) to communicate. The Internet is a public network, and it is open to anyone who has a computer and an Internet connection. It is a vast network of information, and it is constantly growing.

The first stage is to get the data into a structured format. This is done by using a data entry form that is designed to capture the information in a structured way. The data is then entered into a database, which is a collection of data that is organized in a way that makes it easy to search and retrieve. The data is then analyzed using statistical methods to determine the relationships between the variables. The results of the analysis are then presented in a report that is easy to understand and interpret.

in the Department of Microbiology, School of Biology, University of Leeds, Leeds LS2 9JT, UK

It is, generally, a book, which an Ombudsman or a Ministerial Magistrate should be reading.

**Ants and Mammals: Their Interrelationships in Nature.** By R. C. Magnoli and W. M. Collins. Third edition. Pp. 324. Oxford: Blackwell Scientific Publications, 1965.

The empirical literature from the Longwood School of Tropical Medicine has also started up on HIV-related issues. A preliminary study found people get too infrequent and partial education of topics from the HIV lecture only. In addition, lecturers are not always motivated, and students spend more time on the lecture and less time on the lab.

[illegible]

As a common guide and support in the development of such responsibility it is difficult to find any focus, and one can only hope that a considerable proportion of those quoted in this book developed concerns as basic ideas in their practice will be open to widespread dissemination of the available new ideas at the current level of the.

## *Papers of the Service*

### THE ROYAL NAVY MEDICAL CLUB DINNER 1970

The annual dinner of the Royal Navy Medical Club was held in the Purcell Hall in London, September 15, 1970.

The President, Brigadier Vice Admiral E. B. Broadbent, CBE, CMB, MC, MCN, CDSR(D), delivered the following speech:

Vice Admiral Lord Admiral President Distinguished Guests Ladies and Gentlemen

It is my privilege to welcome you all most warmly to Greenwich tonight for this, the annual dinner of the Royal Navy Medical Club. This club held its first dinner in 1928 and it provides the opportunity for a happy social gathering of past and present members of our Service, our Civilian Consultants and our guests. You may be glad to learn that under the eagle eye of the committee, my address is limited in time and content and is recommended for brevity.

Having now completed our full year as the Club, and having seen in some degree how the wheels go round, I realise that one of my main functions this evening is to propose a very sincere vote of thanks to so many who do so much for the Naval Medical Service. Beginning around here, there is that dedicated band of doctors and dentists who do the RNM work. Their support is quite outstanding and their enthusiasm infectious. Not only are these officers most active around here in their discussion, but they have willingly filled a page in our sponsored *Relay* when sickness or unforeseen circumstances have left us temporarily thin on the ground. For those who are constantly stretched 18 medical officers were recalled for short periods and contributed 406 days of sparetime and, in addition, RNL officers joined the Fleet and shore establishments and carried out 1 526 days' training. This flow is essential to our well-being and an addition provides the most worthwhile form of communication—namely, person-to-person, on work and on play. May I add what pleasure it has given me to have had the opportunity to visit some of the RNM Divisions: HMS *Perseus* (London), HMS *Corsham* (Ulster), HMS *Endeavour* (Moray) and HMS *Flying Fox* (Scotia). I found their frequency matched their enthusiasm.

Our deepest thanks go to our Civilian Consultants for their advice and guidance. In these days of rapid specialisation and rapid advances in all the fields of medicine, their close interest in our work and in the problems peculiar to the Service is really important to us.

I would like to pay tribute to the Royal Naval Permanent Research Committee and its many sub-committees and to the value of the work they do for the Navy. In this connection, some of the highlights this year, in conjunction with the RN Physiological Laboratory, were the number of world records set up in deep diving and submarine escape experiments: perhaps the most dramatic of these were the first ascent trials from HM *Salmonette* (short off Malta) in July, when a Royal Navy team escaped from the submarine moving at 1 knot at a depth of 600 feet.

The Naval Medical Service has not been idle during the year. Medical accounting figures show that 24 reforms were selected for continuation during the year, this is about 50 per cent of the applicants. We still require more officers to join over to the Permanent Service, and await with interest to see the effect of the Military Salary introduced on April 1. Also if the revised substantiated Pay Awards will have any impact.

At Haslem the new fully modernised block was opened officially in February by Admiral Sir John Parnes. This statement of intention has proved a great boon to the efficient running of the hospital and I hope will be the forerunner of further modernisation throughout Haslem and similarly at Plymouth Hospital.

Haslem's interests have not all been health and medical, professional bodies were provided by an excellent two day Symposium on Rheumatic diseases and Aspects of Allergy at Haslem which Surgeon Captain Totham, Professor of Naval Medicine organised with his usual skill. Also these valuable dental surgeries continue.

Last Friday the Royal Naval Medical Service had the honour of receiving the President of the Borough of Gosport. This was a unique event in our history and the quiet and cordiality on view was paying in the same regard.

In Malta there has been a delay in the installation of standing equipment in the modernised hospital at Mtarfa. The opening date is now October 1 when Lady Dorman, wife of the Secretary the Governor General has graciously committed to perform the ceremony. It will be called the Great Cross Royal Naval Hospital as a reminder of its distinguished past.

Sherrins has been back in the Naval Hospital at Haslem, possibly the permanent sea retirement as that area have had some hearing on this. Some structural alterations have been planned and I have the pleasant task of visiting there on Monday August, for 11.

The Antibiotic Research Unit in Gosport (Directed under the direction of Surgeon Commander Martin) has completed its pilot studies in all the house block wards which confirm its original findings in Gosport. He submitted the results to the Director General early this year showing how antibiotic resistance in the clinical, X-ray and lung function changes due to antibiotic. Thanks to the enthusiastic support and co-operation of the management of HMS Yards extensive prevention measures have been taken to safeguard employees and in steps antibiotic material has been largely substituted for antibiotics. A long term research programme on a national scale is being looked at jointly by the Navy Department concerned and the Medical Research Council.

The Institute of Naval Medicine is now collecting its first anniversary and its research and activities are burgeoning. The Institute is linked with the role of ensuring that men remain fit however complex and radical their environment and the has led to a flood of responsibilities linked with the needs of the modern, highly complex armed services Navy.

The medical radiation protection field has mirrored with the setting up of sub-marine repair facilities in the Dockyards at Rosyth, Chatham and Devonport. The personnel radiation documentary service now covers the three Armed Forces and some 15,000 film badges are produced and reported on each month. The service is fully computerised so that instant recall of cumulative personal radiation dosage is

available. This has great preventive, clinical and medical legal value. The equipment installed for nuclear work has led to useful spin off benefits and has made it possible to set up a radiobiology training course to cover the diagnosed needs of RNR4 Alaska and also of the NRS in the Western region, covering a population of 2,800,000 people.

A postgraduate medical educational committee is now in being at the Institute which will assume responsibility for all training and will also advise MDGWH on career planning.

A Director of Environmental Medicine has just been appointed. Surgeon Captain Mellow, who will be responsible for all non clinical specialists.

The year 1978 can be claimed to be the Golden Jubilee of the Dental Branch. The Branch did not even begin to exist. The appalling state of Dental Health in the Navy was completely neglected until 1942 when a Medical Officer of Staff Surgeon rank was appointed to carry out dental work as Hunter. In 1948 the first Dental Surgeon was appointed to the Navy, but the Branch remained without until 1955 when the rank of Temporary Surgeon Lieutenant RNRN was introduced. In January 1960 by Order of Council, the RN Dental Service was established. In 30 years they have revolutionised the dental health of the Service. The Navy can be said to have preserved and proved the undoubted value of good dental health and can take a pride in that today virtually no recruits are rejected, the men are motivated, the illnesses are prevented by dental diseases and no patients refuse treatment.

During the year the Dental Branch has continued at full strength and the application for cadetship has been satisfactory. The Branch still offers a varied life. Its officers are serving in ships and 20 hospitals, out of a total of just over 160.

During the year a new dental film co-ordination with the new Do it yourself kit has been produced for the use of medical officers and staff in small ships and submarines to cope with the myriads of dental agony and misery.

Surgeon Rear Admiral (24 Years) says we are now on the threshold of the programme on dentistry. Perhaps it has taken a little bit longer than we all wish but we will not be over 30 years.

Old Chatham heads may be interested to know that our former hospital is now operational and is to be a General Dental Hospital and the NRS has resumed at the Midway Hospital. To stress the Naval connection, I was kindly invited in May to open Floor Two of the rebuilding programme, the Accident and Emergency Centre. This new centre is a substantial, four-story block grafted onto the old block.

We are sorry to lose Westminster Commander Gordon Vaughan who finished his stint on the Navy as a domestic visit to Family Commander at the Preston Community on Friday. He has had the unique distinction of being the first Westminster Officer to receive the Order of the British Empire. We welcome his successor, Westminster Commander Vaughan.

Medical Officers: Quarterly Journals are most valuable records and they also keep the chair borne members of MDGWH close touch with ships and establishments. I am impressed by the variety of the medical problems faced by the doctors when plunging the issues and the efficiency way they handle them. Possibly the doctors in nuclear

instruments carry the most responsibility. They find themselves on a two month cruise underwriter barred from communicating with the outside world.

I like the ingenuity of the Medical Officer of HMS *Assurance* who found himself with two cases of severe shigellosis due in the first week out. After a period of tentative treatment by an ingenious Health Behaviour apparatus, he administered linseed and shell extracts from materials salvaged from the engineers. The result was noted in the fairly fast effective and both rapidly returned to duty. There was great relief in the hotel as this was the result.

The current carrier *High* has just finished the first leg of her commission and I note that the SMO has checked the ship's company for producing so many lovely specimens of the the picture of interesting epidemics. He had 14 cases of appendicitis, some less than this country was not infected in the number of RNR doctors who joined for treatment? Her great patient was the Supply Assistant who was admitted to the Red Bay with a rare disease and subsequently developed glandular fever, meningitis and gastric nodules. A more noted was caused by the leading engine room mechanic who attended for treatment of a splenic abscess and on leaving the Red Bay stepped over a plank board and broke his leg!

Finally I cannot leave the ship without mention of the Commando Carrier *Island*. Under cases of interest the SMO found a young woman who was carried back on board on the course of their first night in Gona. He had recovered a fractured scapula, a fractured humerus and a fractured tibia. The case history stated "This young man visited the window of a lady's bedroom for the door and fell in to the pavement." The hazards and opportunities in the Navy are, and many and varied.

Before I introduce our guests I wish to say what a pleasure it is to have such an opportunity to see Surgeon Vice Admiral Sir Derek Colclough. He has been very rewarding appointments as Executive Director of the Medical Council on Alcoholism.

We are very proud of our close association with the Royal Medical and it is a pleasure of the high regard in which they are held in their own designs and medical progress are happily prepared to compete for the privilege of displaying themselves in their uniform and a great host. We are honoured that Lieutenant General Sir Peter Hollings, Commandant General Royal Marines is with us this evening.

Our distinguished Official Guests, whom we are so happy to have with us, include Sir John Richardson for John comes wearing two hats. President of the Royal Society of Medicine and recently elected President of the British Medical Association. I feel sure his term of office will prove a highly successful and memorable one.

Professor Sir Norman Adcock, President of the Royal Society of Pathologists and Cytopathologists. I would like to acknowledge the support the College gives to us in our family and personal commitments.

Dr John Blum, President of the Royal College of General Practitioners, is another extremely busy man who has found time to help and advise us, particularly in connection with an improved career for the General Practitioner.

Dr Derek Stevenson, Secretary of the British Medical Association. I am sure you will see in conversation him on his civil and diplomatic impressions at the course of the year. The British Medical Association has not forgotten the Service and the

expresses his deep regrets. General Farnes who sat this talk, undoubtedly has been a very fruitful one.

It is a pleasure for us that the Dental world is strongly represented this evening and I refer to Mr. Cohen Cook, President of the British Dental Association, and Mr. H. W. Fiddlers, Dean of the Faculty of Dental Surgery, Royal College of Surgeons.

We have a gallery of Service Tap from Lieutenant General Sir Norman Talbot, Director General Army Medical Service, who is an old friend of the Navy dating back to his school days when he was so greatly admired by all the naval personnel who worked in his hospital.

As Marshal Sir George Gurne, Director General Medical Services of the Royal Air Force, Sir George completes his distinguished term of office at the end of this year. It would like to record the personal pleasure it has given me to work with him and I leave you all with him a happy and ardent retirement.

Major General Matheson, Commandant Royal Army Medical College. Not only does he provide training for our personnel, as medical field parallel to the Army, but he generously permits us to become students of the Midland Wars when pursuing courses of study in London.

Major General Robertson, Director Army Dental Services, who started office on the start of the year and we wish him a very successful year of duty.

Air Vice Marshal Bennett, Director Dental Services, Royal Air Force. I have not met him for many years but it is obvious from his present status that his dental expertise is as low with his skill on the major screen.

Our warm thanks and farewell go to Rear Admiral Coombs, Admiral President of the College, who leaves Greenwich this evening. He tells me he was badly wounded up on the Normandy landings and once his bones had grown to the wonderful skill of Mr. O'Connell who is with us tonight. Apparently Mr. O'Connell had no great difficulty in putting the Admiral's head together but was greatly concerned over his head injury as it was thought he might not be able to hold a pen glass again. A clinical test might be appropriate later.

Among the other guests from our own Service we are delighted to have Rear Admiral McLaughlin, Admiral Commanding Western Division, Captain of the Fleet, Ambassador Weyles, Captain West, Captain of HMS Porpoise.

We are very pleased that the Medical Director General (Deputy) of the Royal Australian Navy, Surgeon Captain Cotwell is able to be here. He is spending three months in England studying our medical organization.

We are most grateful to the RN College Greenwich for offering us the use of the premises and lecture hall and the facilities of the library. My thanks go to Captain Blomster, Captain of the College, Commander Bladen, Commander of the College, the Chaplain, the Reverend St. Ambrose, and to the Staff of the College. The evening would not be complete without the stirring notes of the band of the Royal Marines.

It is a great pleasure to have in our principal guest tonight Vice Admiral Lewis, Chief of Naval Personnel and Joint Sea Lord.

I need hardly remind you that the Royal Naval Medical Service is directly responsible to him. This is the first time he has had an opportunity of meeting so many senior his appointments on March and I trust that the pre medication which we have

unmeasured has produced a sufficient degree of assurance to take him over the actual ship.

Admiral Lewis joined the Royal Navy in 1899. He specialised in Gunners. During the war he had extensive experience of the rugged life in dispatch boats, before graduating to big ship time. After that he had had a number of interesting opportunities, including command of HMS Godolphin during trials with the Floating Gunboat Weapon system, and later he held the key position of Director of Plans in the Admiralty. In 1941 he took over command of the oldest modern guided missile ship, HMS *Amethyst*. Later he became Flag Officer Flotilla Western Fleet and was promoted to Vice Admiral in 1955. For a Naval Officer who has spent so much time at sea he has got some unusual hobbies. He holds the title of Barker of the Yacht Club of Great Britain, perhaps he will be good enough to illustrate this for us. His outdoor interests include walking and skiing in Austria and I am especially struck by his ability to grow his own grapes and to make his own wine.

I now call the members of the Royal Navy Medical Club to rise and join me in welcoming the friends of our Guests.

Vice Admiral Andrew Mackenzie Lewis, CB, Chief of Naval Personnel and Second Sea Lord, replies:

Mr President, Gentlemen

I must confess to feeling great difficulty in talking to members of your profession. I have only to enter a doctor's, or a dentist's, waiting room, to become almost completely speechless, in spite of being a Barista, but I am hoping that in these perhaps somewhat difficult circumstances to do a little better.

With some regret, I must for a short record that in my first few months as Second Sea Lord, the concerns of the Naval Medical Service first visited upon my map. From his lofty eminence, as First Lord, your Director General seems well able to conduct your affairs—and indeed his own too—with great expedition and with little reference to me. Consequently the question of the adequacy of your resources crops up regularly sometimes arising from my desk concerning what I imagine to be almost every six months a batch of worthy doctors and dentists is promoted. Nevertheless I am not fooled into believing that everything in the naval medical service is entirely lovely. I am well aware of problems not far below the surface.

Particularly in the difficulty of continuing indefinitely into the future, the full time career medical service of the sort which has served the Navy so well for so long. The question of replacing our ageing hospital buildings. The pressure to rationalise, and, in some degree, to come closer to the medical services of the Army and the RAF and of the civilian medical service also. These are big questions and they are being tackled. I hope soon that all will approve the picture which will begin to emerge and the changes which are likely to be necessary. Not that change, except change for its own sake is any bad thing. The Navy, of which you are all such an integral and important part is undergoing great changes itself. Partly this has been forced on us, more so indeed, now aggressive country spends more on defence in peacetime than it feels it really needs. And the longer peace lasts the stronger the feeling as the money that money spent on armaments is money wanted. This has been compounded by the technological explosion of the past 25 years which, while it has resulted in ships and

ammunition enormously more lethal than formerly: it has also resulted in far fewer of them being available for the normal man. It is still therefore to hasten the passing of the great days of former days. Actually, in point of fact, the Navy of today is very much the same size, in terms of men, as the one in 1932. In any case the Royal Navy has always been judged more by its quality than by its size, its traditions have been made by men, and not by ships or steel.

It is the organization and execution of those men which, as General Sir Lord is my main preoccupation and concern. Operating as we do ships and weapon systems which are on the very frontier of what is possible in the field of maritime warfare, demands efforts and skills of the very highest quality. And we are competing for those against a world market which has itself now less regard for men who are entitled to or of low calibre. Of course recruiting in all relevant forms of some 60,000 of high quality in such circumstances is bound to be difficult. For every 100 men we recruit, we turn 100 away who, for medical, educational or other reasons, fail to meet the training standards we have to demand. But those standards must and must not be lowered if we are to retain in the future the services at last come to expect of us. If the problem is difficult it is also a challenge and many changes are pending by which I hope it may be solved.

In this, one of the biggest obstacles we face is the attitude which seems to have developed in the country over the past few years, in the profession of arms. There is a tendency now for this to be regarded as something rather shameful, and for the mere fact of possessing ships, aircraft and fighting men is something to be swept under the carpet. Yet the prime role of any government must first be to ensure the safety of those it governs, and to meet in such an emergency as is demanding, important and inevitable a crisis as anyone can embark on. This must be said too often and too loudly, and it is up to everyone of us here to try it, in every possible way—openly, publicly and privately, and to play our part in ensuring the peace of mind of a nation in which we live.

Continuing the theme I said, for a moment, in detail as to the role of the medical branches in the fighting services and more particularly as your role is ours. There is much talk in the medical profession as to what why the forces meet their own medical services at all. By definition the armed forces are mainly composed of fit young men and women, hardly, one might say, those medical needs are small and high as could readily be taken care of by the National Health Service. The line of thought ignores of course the fact that the majority of these fit young people are also bright and within the hours of their own in which many would require their treatment. It ignores the fact that they often serve in places where no civilian doctors are available or under conditions which doctors and dentists need a special training to cope with. But mostly it ignores the morale factor involved in the confidence which a man engaged on a hazardous enterprise looks when he knows that dedicated and high quality medical aid is immediately available if he should need it.

It is this last factor that we, in the Navy, have come to prize so highly. It is not so much in the naval hospitals and various medical administrative services, efficient, honest and geared to naval requirements though they undoubtedly are. It is the presence of naval surgeons in the ships and which means so much, and contributes



so significantly to the morale and efficiency of the Navy. The medical officer of the detached hospital, the young community doctor, the surgeon close at hand when a vessel or airplane is flying—is in the vanguard of the aspect of the Naval Medical Service which I look to you to stress in your many contacts outside, and particularly in the civilian medical world. When you talk about the profession of arms and its value to the country, equally the value of the medical service in the fighting arm of that country is a subject you are all uniquely well qualified to enlarge upon. And I hope and trust you will not be shy about doing so.

It only remains for me now, on behalf of my fellow guests and myself, to thank you for the honor you have done us in taking us to dine with you tonight, and for your truly magnificent hospitality. Thank you very much.

## CONSTANT KITCHEN

Sergeant Lance Adjutant William Edward MAJ (DNE) died on 19 May 1959 aged 47. He served the Royal Navy as P.O. joining the Civil Medical Group Police in his youth, with special commendation for his efficiency in his last job.

He was promoted to Surgeon Lieutenant-Commander on 4 December 1941, and to Surgeon Commander on 4 December 1943. He served as Assistant to Medical Director General (Physical) and was a member of numerous committees of various character within, membership of which he felt as many other sergeants. He did all this with great success and with pleasure to Surgeon Captain on 30 December 1944 for being First Medical Officer of Health in Research.

Advanced studies and treatment in dermatitis for his services in Singapore whilst on the command of 1948. In 1949, he qualified as Assistant to Medical Director General (Physical) (Performance) and was responsible for staff, training and supervision of a training of all medical officers.

On promotion to Surgeon Major Adjutant 1947, he became Surgeon Medical Officer Hospital, and was a member of the General Medical Committee of the R.M.A. and of the Medical Practice Committee of the Admiralty of Health. He was awarded L.P. and Q.M.B. in 1949 and became a Commander in the Order of St. John of Jerusalem. He was placed on the retired list (September 1947).

Sergeant Lance Adjutant William Edward MAJ (DNE) died on 20 May 1959 at the age of 47. He was born on 21 October 1910, and qualified MAJ (DNE) in 1947.

Sergeant Lance Adjutant William Edward MAJ (DNE) died on 20 May 1959 at the age of 47. He was born on 21 October 1910, and qualified MAJ (DNE) in 1947. He was promoted to Surgeon Lieutenant-Commander on 20 September 1947 to Surgeon Captain on 24 November 1947, to Surgeon Major on 20 January 1949, to Surgeon Captain on 20 June 1950, and to Surgeon Major Adjutant on 10 January 1951. He served until 1950.

Sergeant Lance Adjutant William Edward MAJ (DNE) died on 20 May 1959 at the age of 47. He was born on 21 October 1910, and qualified MAJ (DNE) in 1947. He was promoted to Surgeon Lieutenant-Commander on 20 September 1947 to Surgeon Captain on 24 November 1947, to Surgeon Major on 20 January 1949, to Surgeon Captain on 20 June 1950, and to Surgeon Major Adjutant on 10 January 1951. He served until 1950.

After that war, he was in 1949 through which he was involved off Lohmeide in 1951, to 1951, while serving as MAJ. While in the West Indies, he purchased a tropical medicine, under which he had been and also did these Lohmeide operations of his postmaster's staff and his treatment to some extent.

On his return home in 1951, he was appointed to a senior in General Surgery at the Royal Victoria Infirmary, Newcastle, where he held as Clinical Assistant to Professor E. J. Wilson. Professor Wilson was much impressed by his knowledge and capability and asked him the Board to be promoted to that he could join to Surgeon Surgeons.

After that he went to the Royal Naval Hospital, Malta, as Surgeon Resident and continued there until his promotion to Surgeon Captain in 1955. He was changed to R.N. Hospital, Kingston, Jamaica, on promotion to MAJ in 1953, transfer to R.N. Hospital, Malta in 1955. He was promoted MAJ in 1957.

Sergeant Hall was a great sportsman, of his strength, having played both hockey and cricket for the Royal Navy in his college days and, after his retirement, would often be seen at London College Cricket. His stature was always and to some extent a great effect. He gave the impression of a strong and healthy, robust man in his own right, a little taller than most people and most common sense. He was a great and his knowledge and his knowledge.

Sergeant Captain D. H. C. GAVIN MAJ (DNE) died on 1 September 1959 at the age of 35 years.

Sergeant Captain D. H. C. GAVIN MAJ (DNE) died on 1 September 1959 at the age of 35 years. He was promoted to Surgeon Lieutenant-Commander on 11 June 1948. He was promoted to Surgeon Lieutenant-Commander on 11 June 1948, to Surgeon Captain on 11 November 1947, and placed on the Retired List (aged on 8 June 1951) with the rank of Surgeon Captain, Royal-Infantry on 14 June 1950, and retired in Surgeon Commander on 5 November 1950.

Sergeant Captain John Paul MAJ (DNE) died on 23 May 1959 at the age of 75 years.

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Sergeant Commander William E. A. BUCKLAND LORITT MAJ (DNE) died on 23 May 1959 at the age of 75 years.

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1 September: FIC Bayonet Commander Richard Lewis was recalled for duty in FIC. On 4 August, FIC and General held 10 November: FIC.

*Stephen Loring of Theater Works (PFFB, 88-123) was killed in a shooting outside of Rockingham on 12 May 1979. He was 30 years of age.*

Tom Pump served in the Royal Naval Medical Service as a Surgeon Lieutenant on 11 April 1945 and served for five years. He spent most of his service time with the Royal Medical Commando and was awarded the two most famous Service Medals of Great Britain, (Victoria) in the summer of 1950.

[illegible][illegible][illegible]

Bergman Caplan (20) Naval War Coll. 1944-1946 BS (Eng.) died on 17 July 1978 at the age of 58 years.

56 years (Captain White earned the Navy Dey in a Singapore Landward (X) on 4 September 1911. He was promoted to Singapore Landward Commander (X) on 4 September 1919 to Singapore Commanding (X) on 11 December 1912 and to Singapore Captain (X) on 14 December 1919. He was placed on the retired list when he was 66 years of age on 30 July 1947.

<sup>2</sup> The report of the Mayor of Saint-Wulff states that a great church is to be built, however the identity and the nature of the work.

Typically, he just references a single article in *Frontiers*, *Quarterly*, or *de Jure* when he lectures on "social contracts" to laypeople, and usually, typically, just refers to *de Jure* in American law classes, though in law school, I heard of him doing lecture after lecture on legal doctrine, including the "social contract" of "rights." (Caveat: I'm a lawyer.)

Transferring to Navy is required for proof that Armed Navy in September 1944 and served with immediate recognition and awarded the decoration and its endorsement in May 1945

There was a second possibility – a financial disaster? In all likelihood not really, but I was surprised the banks were so much willing to give, probably being aware of the trend, but it is hard to say. Indeed, I don't think the banks were so naive, and the business community

The work is fully illustrated with photos and life sketches of his subjects. For the first time, we learn that the monks in monastic hospitals, some of the noblest and richest in those centuries, whom he speaks, and many other officials at present serving in the Royal navy, joined in his anti-slavery work.

**Children in language: some** Native English and old French children's language South is not the same type of language and it will be of more importance to study that the real world in the language of school is the

Have you already been told to be happy that way?  
 A. B. C. (100000)

Four members of the Clinical Branch are now gone home, as well known as Doug Ross, Walter  
 Cunningham, James Walker, and Dr. John. The remaining two, Dr. Ross and Dr. Walker, are still in the  
 hospital.

There was a third incident, and here I will be sworn to say that the divided task was done by three persons, namely, the two men and the girl, the latter being in full control of the situation.

relating with the... but these are examples of... and the... and the... and the...

The response to prevent the spread of the virus was to shut schools, health services and businesses. The government also closed all international airports. The spread among more senior officers, who were

average weight for males was not significantly different between the two shipping lots of these stations. Means of variance that is better found as ratios of variance.

\_\_\_\_\_

He was consistently generous and sympathetic and I must honestly admit that he did it along with his sense of duty and loyalty to his country. From his position as a member of the Board, Lady's and the Royal Society's Committee, and his position as a member of the Board of the Royal Society, he was able to do much for the cause of the Royal Society and the cause of the Royal Society's Committee.

There was a time when he was in the Royal Society's Committee and he was in the Royal Society's Committee and he was in the Royal Society's Committee and he was in the Royal Society's Committee and he was in the Royal Society's Committee.

Perhaps it is better to leave this matter to the Royal Society's Committee.

In a 1944 paper (1944) on the death of Joseph Chamberlain (1836-1914) at the age of 77.

Joseph Chamberlain (1836-1914) was a member of the Royal Society's Committee and he was in the Royal Society's Committee and he was in the Royal Society's Committee and he was in the Royal Society's Committee and he was in the Royal Society's Committee.

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His father, Lord Henry Cavendish, died suddenly on his home on 11 June 1909.

L. J. P. and P. J. P. are also.

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